TAHOE REGIONAL PLANNING AGENCY

VEHICLE ELECTRIFICATION DATA COLLECTION AND MODELING

JULY 2024

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Executive Summary

Tahoe's transportation system is one of the leading sources of stormwater pollution that impacts lake clarity and greenhouse gas (GHG) emissions that contribute to climate change. The Tahoe Regional Planning Agency's (TRPA) Regional Transportation Plan includes reducing vehicle emissions and promoting alternative fuel vehicle use, particularly electric vehicles (EV), as a key strategy to protect the environment. While the Region's overall goal is to reduce the total number of vehicle trips, if vehicle trips are going to happen, they should be made with no or low-emission vehicles.

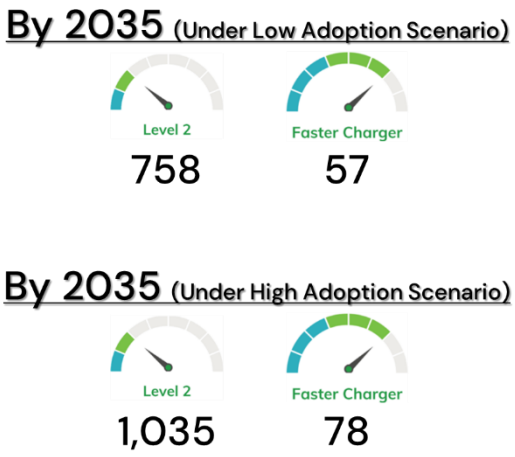
In 2017, the TRPA and Truckee-Donner Public Utility District partnered to create an EV readiness plan for the region. Nearly seven years have passed since the adoption of the initial EV Readiness Plan, signaling a pressing need for an update. The landscape of EV adoption and infrastructure has evolved significantly over this period, necessitating a fresh approach to data and strategy. With growing EV use in the region and increased California mandates to transition to EV, more charging stations will be needed to meet future demand.

EV Charging Needs Assessment

In recent years, the Tahoe Region has seen a steady increase in plug-in electric vehicle (PEV) registrations. By 2022, there were approximately 436 PEVs registered on the California side and an estimated 280 PEVs on the Nevada side of the Tahoe Basin. However, this figure represents only 1.4 percent of the total registered vehicles in the region, indicating significant potential for further market penetration. This modest share of PEVs highlights an opportunity for increased adoption and infrastructure development to support the growing number of electric vehicles. The current assessment also reveals that the Tahoe Region has a total of 127 publicly available EV charging ports distributed across 45 charging stations. A significant portion of these chargers are concentrated in South Lake Tahoe, Incline Village, and Tahoe City, with 85% provided by ChargePoint and Tesla.

To better understand the need for charging infrastructure in the region, future projections for PEV adoption have been developed under three scenarios—low, medium, and high. These scenarios take into account varying market and regulatory conditions in both the California and Nevada segments of the Tahoe Basin. The projections incorporate the unique market dynamics and regulatory environments of each state, with adjustments for the significant number of visitors to the region. The scenarios indicate that by 2035, the region could host between 31,000 and 40,000 PEVs, leading to significant reductions in greenhouse gas (GHG) emissions, ranging from 79% to 83% by 2050.

To meet the future EV infrastructure needs, the team utilized the National Renewable Energy Laboratory's Electric Vehicle Infrastructure Projection Tool (EVI-Pro). This tool estimates the quantity and type of charging ports necessary based on PEV adoption projections and the percentage of PEV owners with access to home charging. The results suggest that by 2035, the Tahoe Region will require between 758 and 1,035 Level 2 chargers and 57 to 78 DC Fast Charging stations to accommodate the projected growth in PEVs.



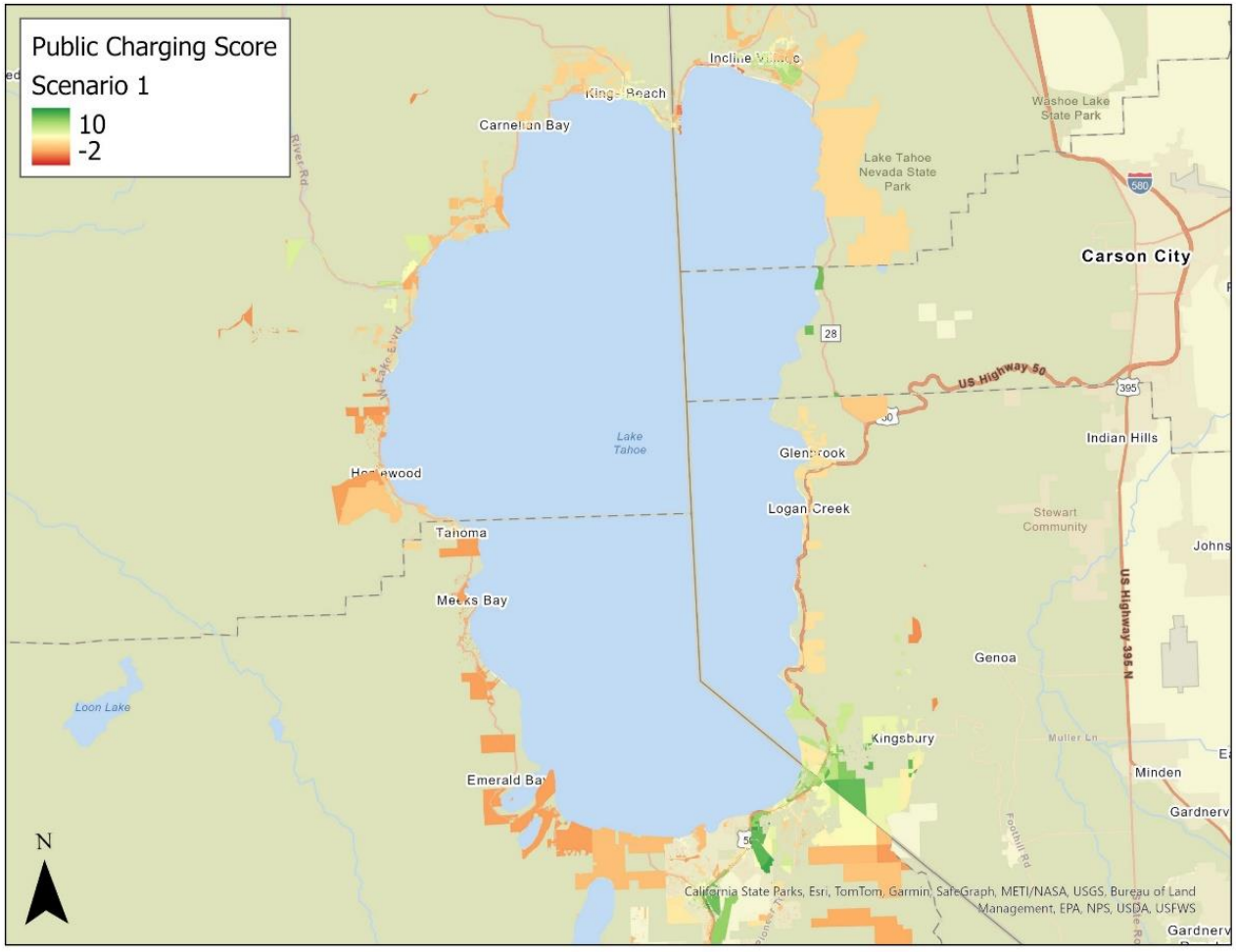
EV Charger Siting Analysis

Deploying such a network of public EV charging infrastructure requires significant investment. This is why it is important to strategically site these chargers with the goal of maximizing the return on investment, improving accessibility, and promoting equity. When stations are sited in locations frequently visited by light-duty EV users, they are more likely to be utilized, leading to a quicker recoupment of the initial investment. Secondly, proper siting ensures increased accessibility. EV adoption is more likely to proliferate if potential users know they can easily access charging points, both within urban centers and along major transit routes. This accessibility not only promotes more extensive EV usage but can be a decisive factor for potential EV buyers. Lastly, appropriate siting plays a vital role in advancing equity outcomes. Ensuring that public EV charging infrastructure is available in diverse neighborhoods, and not just affluent or densely populated ones, makes clean transportation options accessible to all, irrespective of socio-economic status.

To determine the most appropriate locations for placing EV chargers for light-duty vehicles, it is important to understand the travel behavior of drivers in the Tahoe Region so that chargers can be sited to meet those needs. The project team used Replica travel data for personal trips both in and out of the Tahoe Basin to understand which areas see the most traffic and to learn more about characteristics of those trips like distance, stopping (or dwelling time). This data was leveraged to develop travel demand scores for different scenarios and to distinguish which type of chargers would be best suited for each site, level 2 (L2) or direct current fast

charging (DCFC). The demand scores were also adjusted to account for locations with nearby chargers. Moreover, additional points were added to account for nearby transit, locations within Community Priority Zones (CPZ), and locations in proximity to truck stops and distribution centers. Figure ES1 summarizes the results of the siting analysis conducted.

Figure ES1. Results of Parcel Scoring – Scenario 1 Score
(a higher score indicates a more favorable location based on the specified criteria)



As expected, the highest-scoring sites are found in South Lake Tahoe, outside the quarter-mile radius of existing EV chargers, with several high-scoring locations in Incline Village's commercial district and downtown Tahoe City. Beach parking at Kings Beach scores particularly well due to longer trip dwell times. The east side of Lake Tahoe has fewer suitable sites due to predominant Open Space or Residential land use and lower trip demand compared to other hotspots.

E-Mobility Assessment

In addition to assessing EV infrastructure, this report also includes a white paper on e-bike and e-mobility charging, adoption, and best practices. It reviews the current micromobility landscape in the Lake Tahoe Basin and offers recommendations for improving and expanding

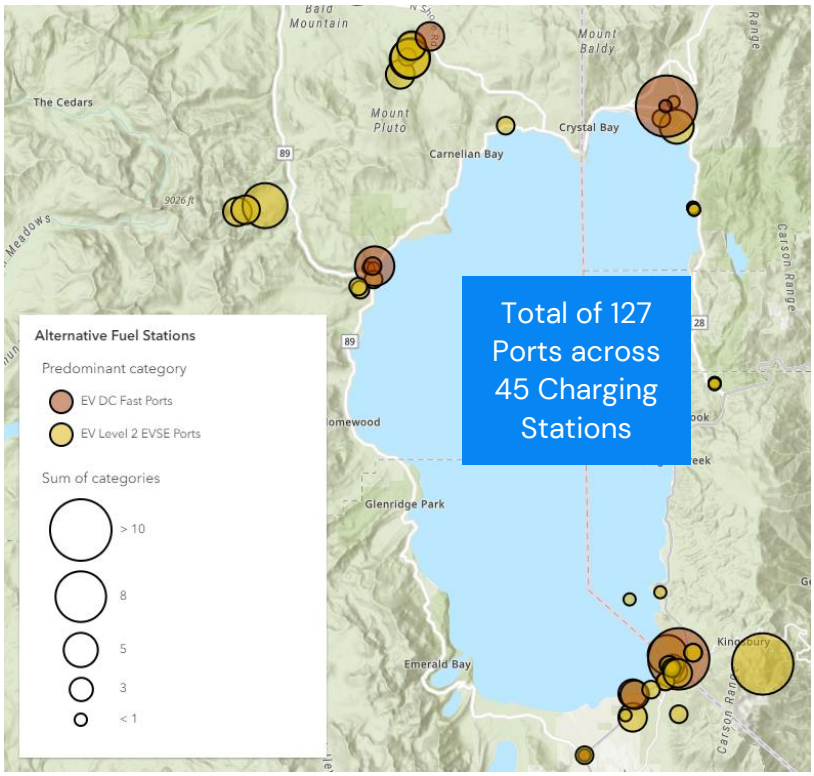
existing programs. As part of this white paper, the project team has conducted detailed analysis of data from Lime and Bird, the two e-mobility companies currently operating in the Tahoe Region. Using the data analysis, the project team provided a set of recommendations which focused on three main topics: policy changes, bikeshare, and key areas for ridership and investment. Regarding policy, the project team recommends implementing more robust requirements for equity programs and data sharing to enable Tahoe to better understand the evolution of these programs over time and assess the effectiveness of policy interventions. For example, South Lake Tahoe recently introduced scooter "corrals," but without comprehensive data from Lime on rider safety, ride cost, or program equity, it will be difficult to evaluate the impact of this change. The project team also highlights several ways program fees can enhance ridership rather than solely fund enforcement.

In the review of bikeshare, the project team identifies the pros and cons of bikeshare compared to scootershare and ultimately recommends that the Tahoe Region consider adopting a bikeshare program. Additionally, the project team reviewed ridership focus areas in South Lake Tahoe and compared them with proposed scooter corral sites. The analysis reveals a notable safety concern for riders near the Stateline Transit Center, the highest ridership area, which lacks sufficient bicycle infrastructure. Therefore, it may be sensible to include a corral on either side of Highway 50 to prevent riders from crossing it. The project team also recommends augmenting the corrals with low-cost infrastructure to help riders find them and keep the scooters organized.

Exiting Condition Assessment

EV Charging Infrastructure

Figure 1. Public EV Chargers in TRPA



To assess the status of the EV charging infrastructure, the project team employed the Alternative Fuel Data Center (AFDC) Alternative Fueling Station Locator[1] to map and collect comprehensive details on the EV charging stations throughout the region. This included information on the types of plugs and the various charging levels available at each station.

According to the Alternative Fuels Station Locator, there are currently 45 unique charging locations offering publicly available charging in the Tahoe Basin, representing a total of 127 EV charging ports. Approximately 85 percent or 108 EV charging ports are provided by two EV service providers (EVSPs): ChargePoint, and Tesla, with Tesla comprising the majority. As illustrated in Figure 1, most of these chargers are concentrated within South Lake Tahoe, Incline Village, and Tahoe City. According to AFDC's

[1] https://afdc.energy.gov/stations

Station Locator, out of the 45 charging stations, 16 of them offer free charging. Table 1 below summarizes the number of chargers by charging speed and EVSP network in the basin.

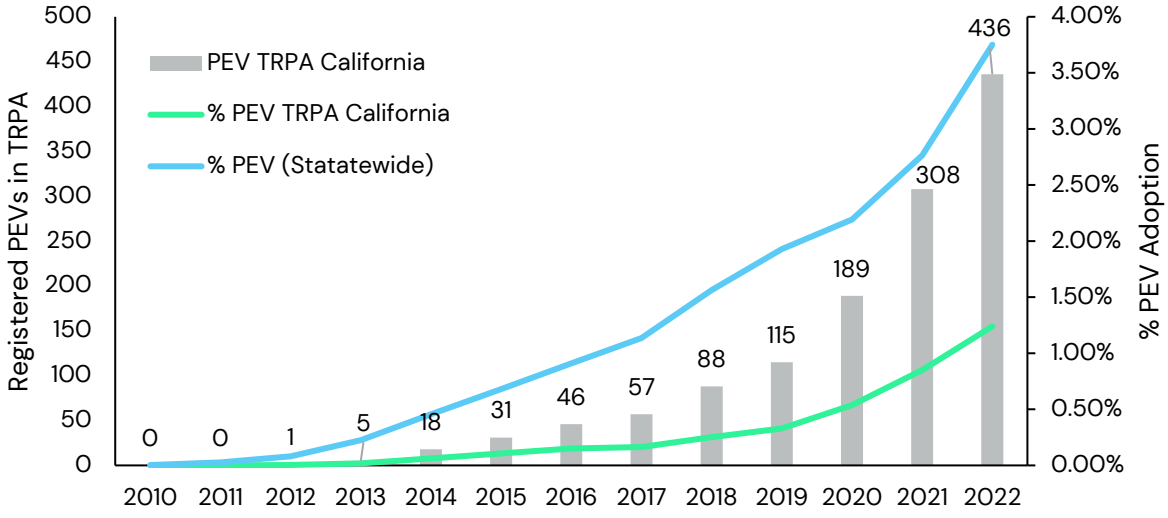
Table 1. TRPA Public EV Charger Count

EVSP	L2	DCFC	Total Number of Chargers
Non-Networked	10	0	10
Tesla Destination	42	0	42
Tesla	0	38	38
ChargePoint Network	26	2	28
Electrify America	0	4	4
EVgo Network	0	2	2
EVRANGE	1	0	1
Blink Network	2	0	2
Total	81	46	127

PEV Adoption

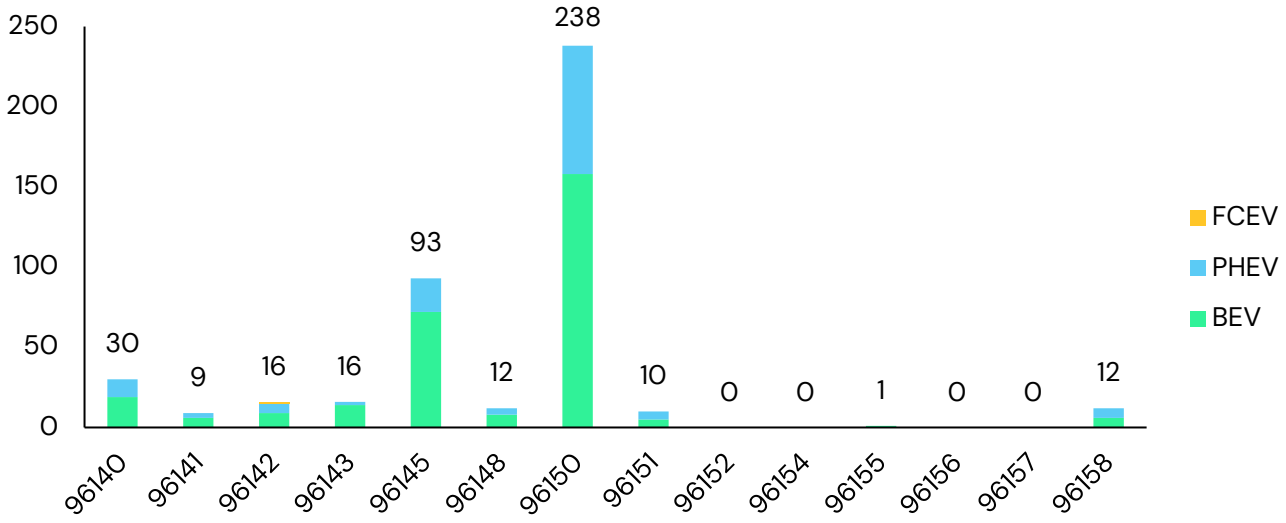
To evaluate the current registrations of PEV in the Tahoe Region, the project team employed different data sources to compare the California and Nevada portions of the Tahoe Basin. For the California segment, the team utilized the California Energy Commission's (CEC) zero emission vehicle (ZEV) dashboard. This resource provided us with the most up-to-date ownership rates for Battery Electric Vehicles (BEV) and Plug-in Hybrid Electric Vehicles (PHEV) categorized by zip code. According to this data (also as illustrated in Figure 2), at the end of 2022, there were 436 PEV registered in the Tahoe Region with 298 being BEV and 138 being PHEV. This represents a 1.25 percent PEV adoption across the fleet which is significantly lower than California average fleet adoption of 3.75 percent.

Figure 2. Light-Duty Vehicle Population one the California side of the Tahoe Basin



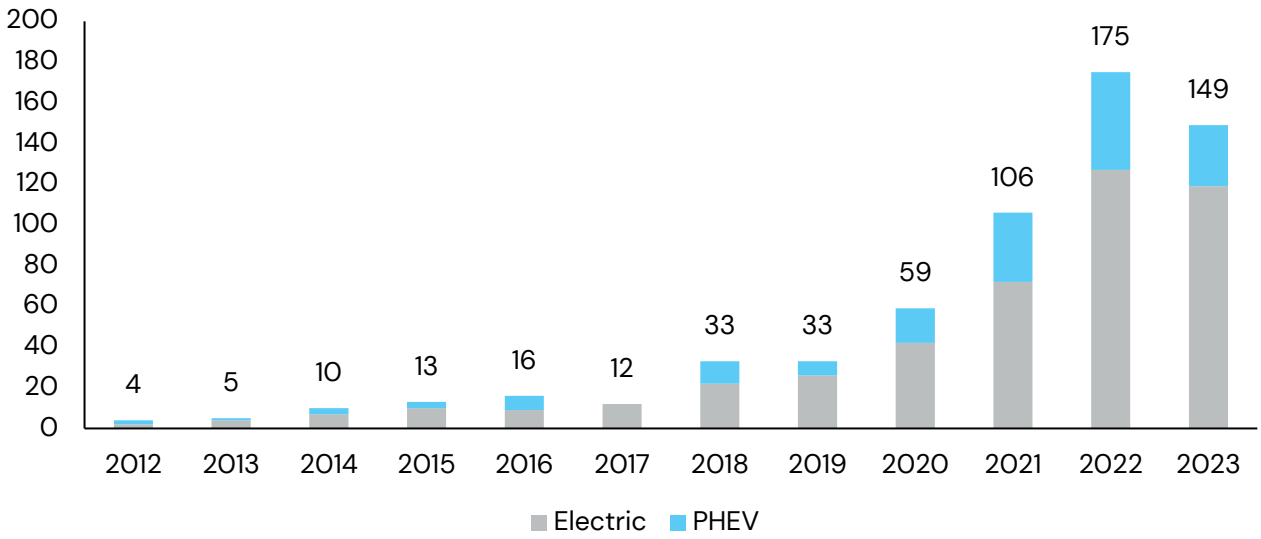
Similar to charging infrastructure, the majority of these PEVs are registered within South Laske Tahoe (zip code 96150), Tahoe City (zip code 96145) and Carnelian Bay (zip code 96140).

Figure 3. PEV Adoption in California portion of Tahoe Basin by Zip Code



In the California segment of the Tahoe Basin, approximately 149 new PEVs were registered in 2023. However, the project team had access to new vehicle registration data (for all fuel types) at the zip code level only for 2021. Consequently, we were able to calculate the market share of PEVs for that year. It was determined that PEVs constituted 11.4 percent of all new vehicles registered in 2021 as compared to a statewide market share of 12.4 percent.

Figure 4. New PEV Registered in California side of the Tahoe Basin



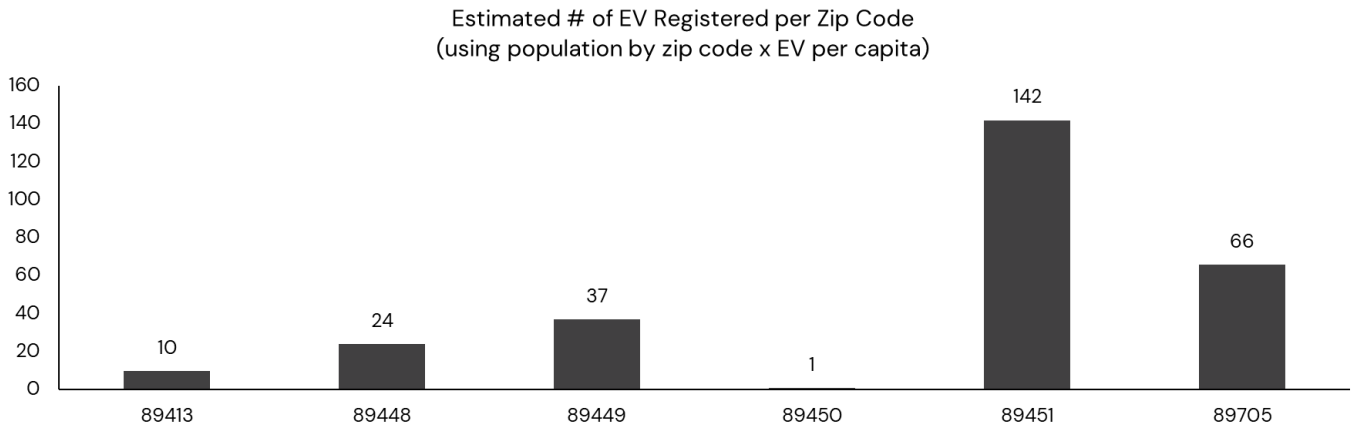
On the Nevada side of the Tahoe Basin, public vehicle registration data was not readily available, presenting a challenge in gathering localized EV registration statistics. The project team, therefore, contacted the Nevada Department of Motor Vehicles (DMV) and managed to obtain EV registration data at the county level. Although the Nevada DMV also provided zip code level data, inconsistencies within this dataset led the team to decide against using it for this analysis. Instead, we utilized the county-level PEV registration data to perform a calculation of PEV per capita, which is the number of PEVs registered per 1,000 people, for

both Washoe County and Douglas County. Using these PEV per capita figures, the team estimated the number of PEVs for each zip code within the Tahoe Basin that falls under these two counties. The estimated number of PEVs within each zip code of interest is illustrated in the project team estimated a total of 280 PEVs registered on the Nevada side of the Tahoe Basin. Notably, a significant portion of these registrations, amounting to 142 PEVs, occurred in the Incline Village area, designated by the zip code 89451.

Figure 5, the project team estimated a total of 280 PEVs registered on the Nevada side of the Tahoe Basin. Notably, a significant portion of these registrations, amounting to 142 PEVs, occurred in the Incline Village area, designated by the zip code 89451.

Figure 5. Estimated PEV Registration – Nevada Side of the Tahoe Basin

Total EV Registered in Washoe County as of 2024 7,339	Washoe County Population as of 2021 493,392	# of EV Registered per 1000 People – Washoe County 14.9
Total EV Registered in Douglas County as of 2024 629	Douglas County Population as of 2021 49,870	# of EV Registered per 1000 People – Douglas County 12.6



PEV Projection

To accurately forecast the future needs of EV charging infrastructure in the Tahoe Basin, the project team undertook a detailed analysis to project the potential number of PEVs in the region up to the year 2050. Initially, the team developed three scenarios—low, medium, and high—regarding the new vehicle sales market share of PEVs. These scenarios were distinctively crafted for both the California and Nevada segments of the basin, reflecting the unique market dynamics and regulatory environments in each state. The market share assumptions for each scenario were then integrated into the EMFAC2021 model[2], a robust tool used for forecasting vehicle emissions and adoption trends, to estimate the probable number of PEVs operating in the Tahoe Basin in the coming decades.

Additionally, considering the significant influx of visitors to the Tahoe Basin throughout the year, the projected numbers of PEVs were adjusted based on visitation data. This adjustment was crucial to provide a more comprehensive understanding of the overall demand for EV charging facilities, taking into account not only the resident population but also the seasonal peaks due to tourists and visitors. This approach ensures that future infrastructure planning can adequately meet the anticipated needs. Further details and implications of the visitation data on PEV projections will be discussed in subsequent sections of this report.

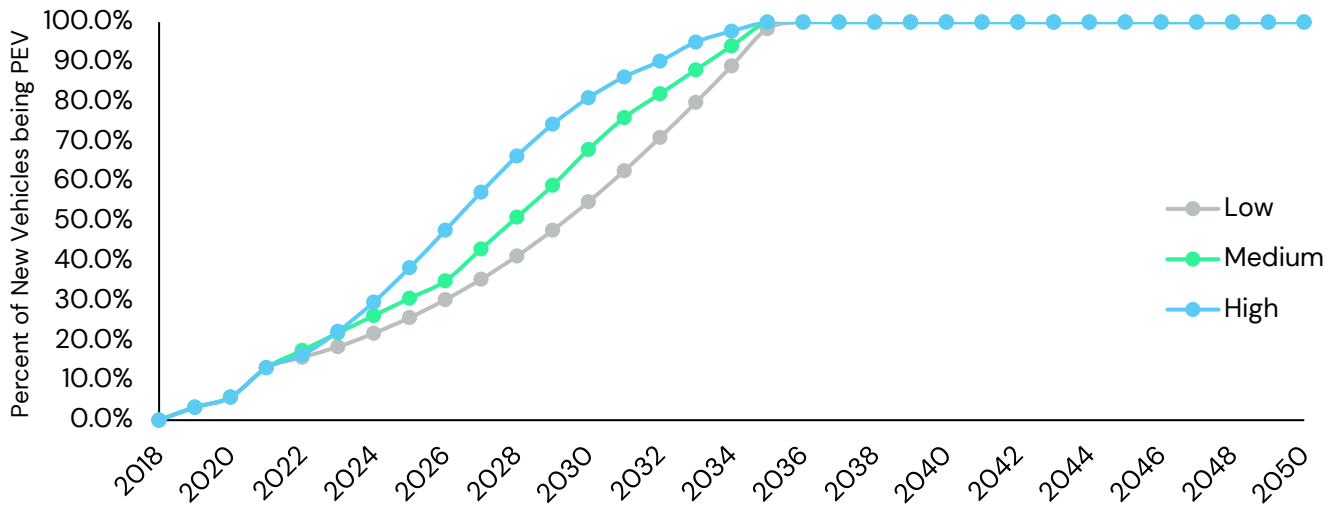
California Scenarios

For the California segment of the Tahoe Basin, the project team developed three scenarios to project the adoption rates of PEVs. These scenarios are designed to reflect different rates of adoption based on various regulatory and market influences.

- **Medium Scenario**: This scenario aligns with the California Advanced Clean Cars 2 (ACC 2) regulations, assuming that the adoption rate will follow the state's current legislative framework without acceleration or delays.
- **Low Scenario**: This scenario projects a slower adoption rate than what is stipulated by ACC 2. It assumes that while the goal of achieving 100 percent new PEV sales by 2035 remains, the pathway to this target will be less aggressive, with only 50 percent of new vehicle sales being electric by 2030.
- **High Scenario**: Conversely, this scenario envisions a faster adoption rate than ACC 2. It maintains the ultimate goal of 100 percent new PEV sales by 2035 but predicts a more rapid uptake, with 75 percent of new vehicle sales being electric as early as 2030. This scenario anticipates stronger market penetration and possibly more supportive policies or technological advancements that boost PEV adoption.

[2] https://arb.ca.gov/emfac/

Figure 6. California side of Tahoe Basin – EV Market Share Assumptions

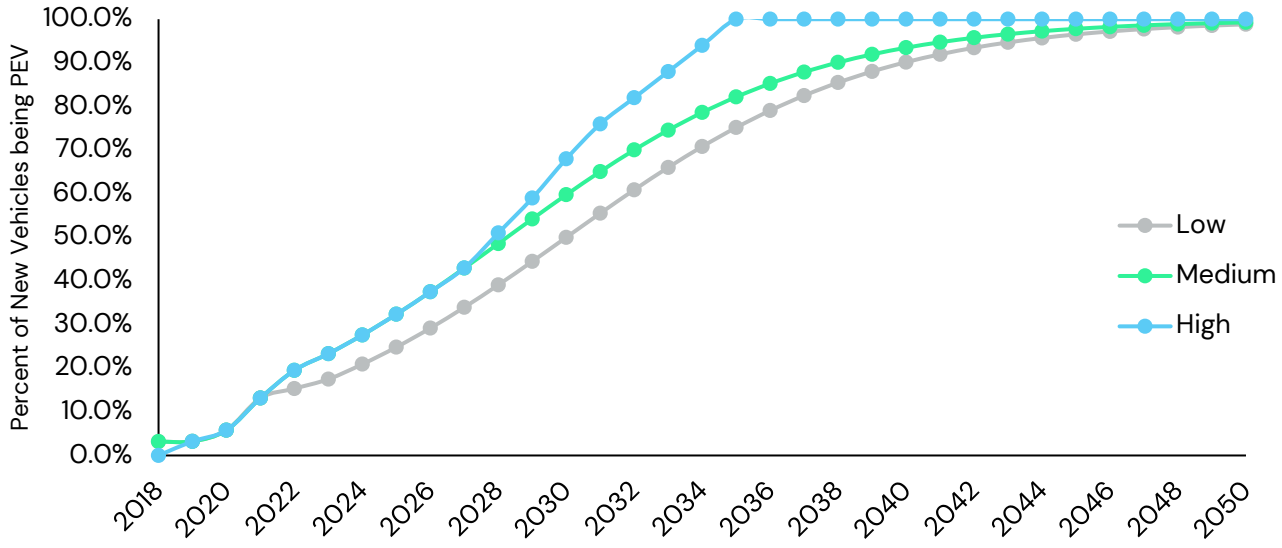


Nevada Scenarios

For the Nevada side of the Tahoe Basin, the project team also developed three scenarios to project future PEV adoption rates. These scenarios were designed to account for different regulatory and market dynamics that may influence PEV uptake in this area.

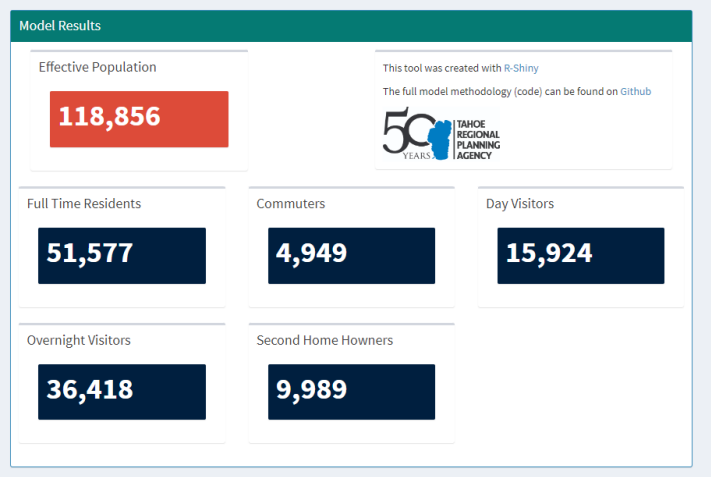
- **Medium Scenario**: This scenario is based on the EPA Multi-Pollutant Standards projected for the 2027 – 2032 model years. Under this framework, the scenario anticipates reaching 100 percent EV sales by the year 2050, aligning with moderate regulatory pressures and gradual market acceptance.
- **Low Scenario**: Here, the adoption rate is expected to be slower than what the federal proposed standards might suggest. This scenario forecasts 50 percent EV sales by 2030 and aims to reach 100 percent EV sales by 2050. It considers potential delays in market readiness and less aggressive regulatory enforcement.
- **High Scenario**: This scenario adopts the ambitious targets of California's ACC 2 regulations, despite being applied to Nevada. It envisions a rapid increase in EV adoption, matching California's aggressive goals and possibly reflecting stronger local or state incentives that align closely with California's regulatory environment.

Figure 7. Nevada side of Tahoe Basin – EV Market Share Assumptions



Visitation

Figure 8. Effective Population of Tahoe Basin



To accurately account for the influence of visitation on the infrastructure needs of the TRPA, the project team developed a method to adjust for the fluctuating population due to tourists and day visitors. Recognizing the unique demographic dynamics of the area, the team started by estimating what they referred to as the "effective population," which excludes commuters and day visitors. This figure helps in understanding the actual usage strain placed on local resources and infrastructure by those staying in the region temporarily but significantly longer than day visitors. According to data provided by TRPA[3], the effective population was determined to be 87,984, as provided by TRPA data.

The next step involved calculating a scaling factor to bridge the gap between this effective population and the full-time resident population, which stands at 51,577. Specifically, with an effective population of 87,984 and a full-time resident population of 51,577, the team calculated a visitation correction factor of 1.71.

Fleet Modeling Results

To conduct the fleet modeling for TRPA, the project team adopted a six-step methodology.

[3] https://trpa.shinyapps.io/effective_population/

1. **EMFAC2021 Data for TMPO**: The process began with sourcing the base data from the EMFAC2021 model, which provides detailed emissions factors and vehicle activity data. This model was specifically applied to the Tahoe Metropolitan Planning Organization (TMPO) to gather initial estimates relevant to the local context.
2. **Scale EMFAC Data to Match TRPA Vehicle Registration**: The team then scaled the EMFAC data to align with actual vehicle registration data from the TRPA. This step was critical in ensuring that the model reflects the true composition of vehicles within the Tahoe Region, rather than relying solely on broader regional estimates in EMFAC.
3. **Correct for Visitation**: Recognizing the significant impact of tourism in the region, the team corrected the scaled data for visitation. By using a visitation correction factor of 1.71, derived from the ratio of effective population to full-time residents, the model adjusted to account for increased vehicle usage during peak tourist periods, ensuring a more accurate representation of vehicular impact on infrastructure and environment.
4. **Run Scenarios for CA**: With the calibrated data, the team ran the three scenarios for the California side of the Tahoe Basin, exploring different trajectories of PEV adoption based on varying regulatory and market conditions, such as those outlined by California's Advanced Clean Cars II regulation.
5. **Run Scenarios for NV**: Similarly, scenarios were also run for the Nevada side, considering local factors and potential regulatory changes that might influence EV adoption rates differently from California.
6. **Combine the CA and NV Results**: Finally, the outcomes from both state-specific scenarios were combined to provide a comprehensive overview of the future vehicle fleet within the entire Tahoe Basin.

The output of the fleet modeling exercise included a detailed forecast of the vehicle population by fuel technology, which was segmented into various categories such as gasoline, diesel, plug in hybrid, and fully electric vehicles. Additionally, the model generated data on fuel consumption and greenhouse gas (GHG) emissions, quantifying these impacts in units of gallons per year and metric tons of CO2 per year, respectively. Results from the fleet modeling are presented in Figure 9, Figure 10, and Figure 11.

The results demonstrate significant growth in the presence of PEVs and a substantial reduction in greenhouse gas (GHG) emissions by 2050. Specifically, under the low adoption scenario, the region is projected to host over 31,000 PEVs by 2035 and 86,000 by 2050. For the mid adoption scenario, these numbers increase slightly to 36,000 PEVs by 2035 and 88,000 by 2050. The high adoption scenario predicts even stronger growth, with more than 40,000 PEVs by 2035 and reaching 91,000 by 2050. Importantly, all three scenarios result in a substantial decrease in GHG emissions, with reductions ranging from 79 to 83 percent by 2050 compared to the 2050 business-as-usual estimates.

Figure 9. Fleet Modeling Results – Low Adoption Scenario

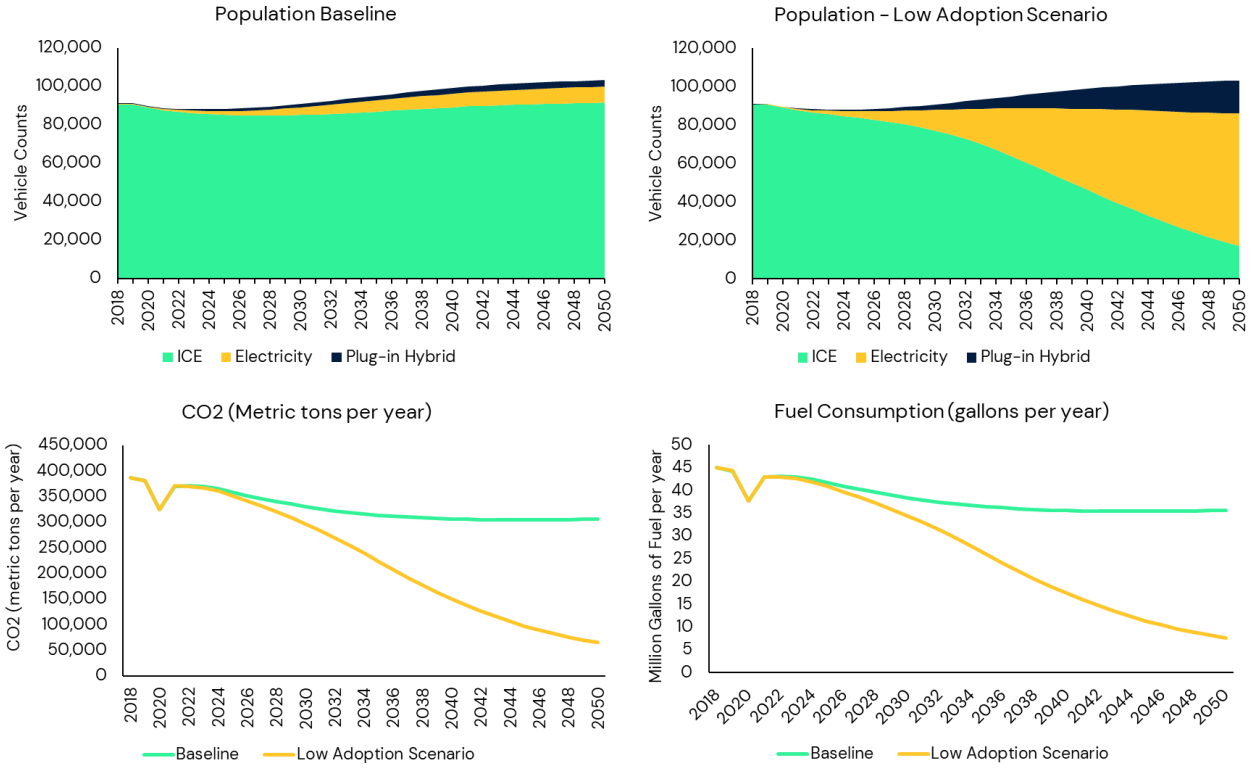


Figure 10. Fleet Modeling Results – Mid Adoption Scenario

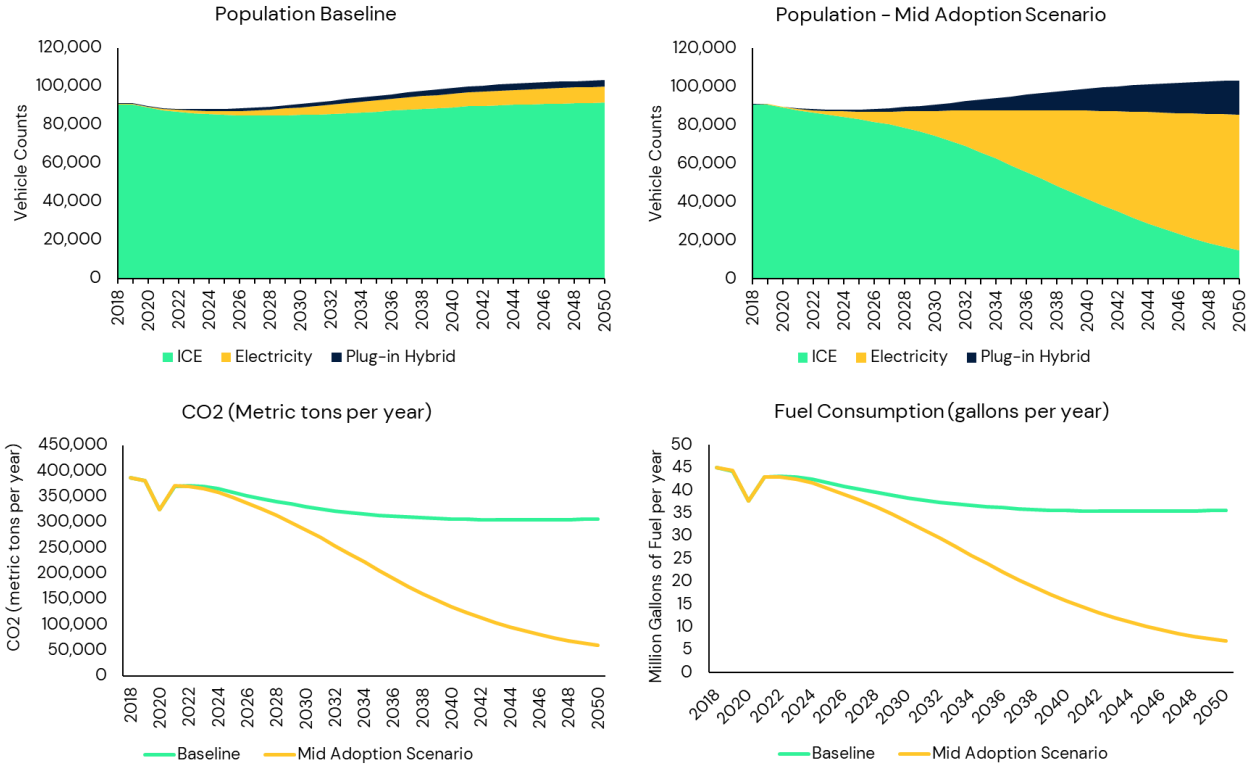
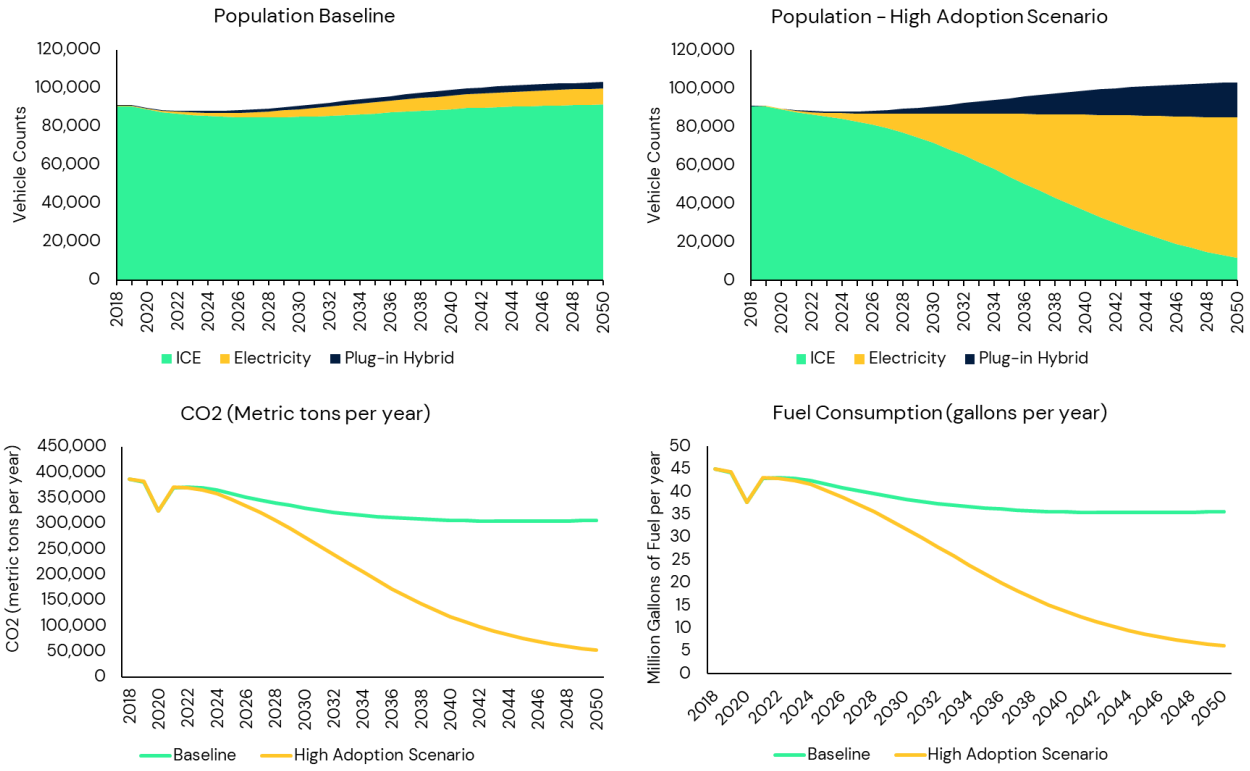


Figure 11. Fleet Modeling Results – High Adoption Scenario



EV Infrastructure Needs Assessment

To estimate the number of charging ports needed to meet the incoming flux of PEVs within the TRPA, the project team used the NREL's Electric Vehicle Infrastructure Projection Tool (EVI-Pro).[4] EVI-Pro uses 2017 National Household Travel Survey (NHTS) data in bottom-up simulations to estimate the quantity and type of charging ports necessary to support regional PEV adoption. The tool estimates regional charging port distributions using two key inputs: the number of PEVs[5] to support and the percentage of PEV owners with access to home charging. The number of PEVs to support by region and calendar year is taken directly from the fleet modeling exercise described in the previous section. Residential charging potential, or the percentage of PEV owners with access to home charging, is an important figure that determines how much residential and public charging infrastructure is needed. The higher the access to home charging, the lower the need for public charging infrastructure.

NREL's No Place Like Home Study[6], which examines the potential for residential charging according to housing type, takes into account various scenarios derived from a residential parking and electrical survey conducted by the organization. This study shows that the percentage of PEV owners with access to home charging facilities can depend on residential electrical wiring, parking behaviors[7], and the overall fleet PEV stock share. The project team assumes that most EV owner will keep the similar parking preference[8] over time, while some EV owners may add electrical outlets at their normal parking locations. As a result, roughly 87% of EV owners in Tahoe Basin will be able to plug in and charge at home by 2030, and this number drops to 63% by 2050, with small variances across three modeling scenarios. The primary cause for the decline in access to home charging for PEVs stems from the anticipated growth in the PEV market. As the number of PEVs on the road increases, it is probable that a larger fraction of PEV owners will find themselves without home charging options. Initially, PEV owners are likely to be individuals living in single-family homes—these early adopters have easier access to home charging solutions. However, as the market expands, a broader demographic, including those residing in multi-unit dwellings, rental properties, and locations without direct access to home charging infrastructure, will begin to adopt PEVs. With the fleet modeling results previously derived, as well as the assumed home charging access, detailed infrastructure needs for personal light-duty PEVs were then queried using EVI-Pro model.

Figure 12, Figure 13, and Figure 14 provide detailed visualizations of the projected needs for electric vehicle charging infrastructure in the Tahoe Basin based on the growth of PEVs under various scenarios by 2035. The results indicate that by 2035, the TRPA will require between 760 to 1,035 Level 2 chargers and 57 to 78 DC Fast Charging (DCFC) stations to accommodate the expected number of electric vehicles. Currently, as depicted in Table 1, the region is

[4] https://www.nrel.gov/transportation/evi-pro.html
[5] Note that the ratio of BEVs versus PHEVs serves as an input to EVI-Pro as it impacts the overall PEV charging needs.
[6] https://www.nrel.gov/docs/fy22osti/81065.pdf
[7] Where people normally park their vehicles when they are home (e.g., garage, driveway, curbside outside the house)
[8] For instance, if someone currently prefers to park their vehicle on a driveway, they may continue doing so with an EV.

equipped with approximately 81 Level 2 chargers and 46 DCFC chargers. While the need for DCFC chargers is anticipated to roughly double, a significant expansion is necessary for Level 2 chargers, with an estimated tenfold increase required to meet future demands. This highlights a crucial area for development within the region's charging infrastructure, emphasizing the need for a strategic scaling up of Level 2 facilities to support the growing adoption of PEVs.

Figure 12. EV Infrastructure Needs Assessment – Low Adoption Scenario

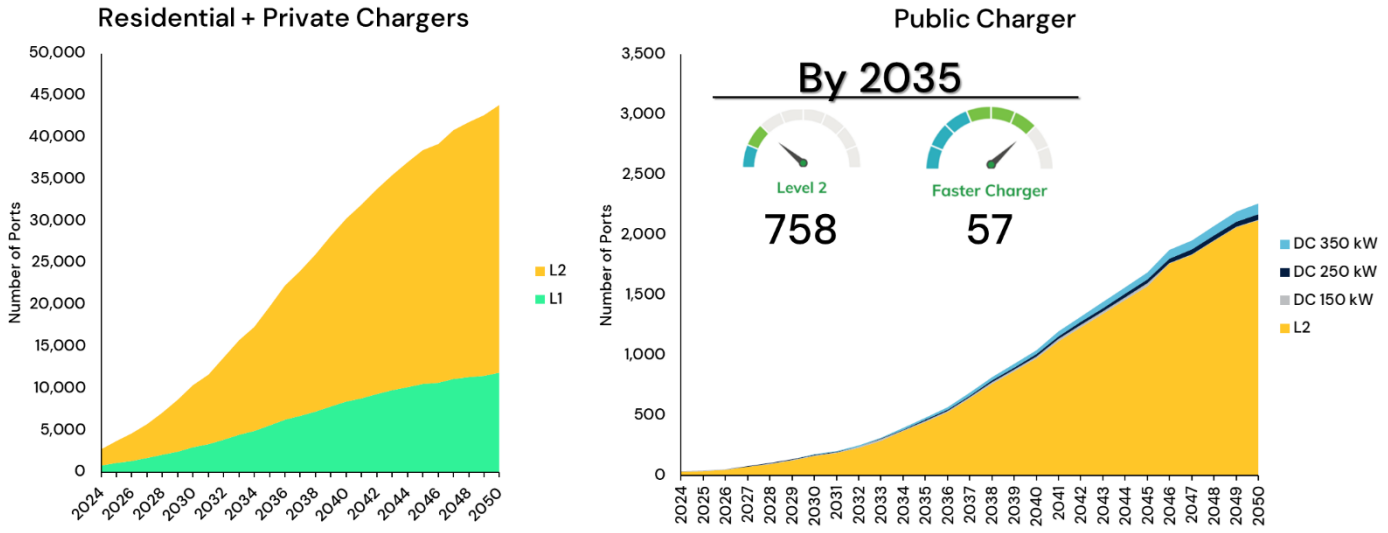


Figure 13. EV Infrastructure Needs Assessment – Mid Adoption Scenario

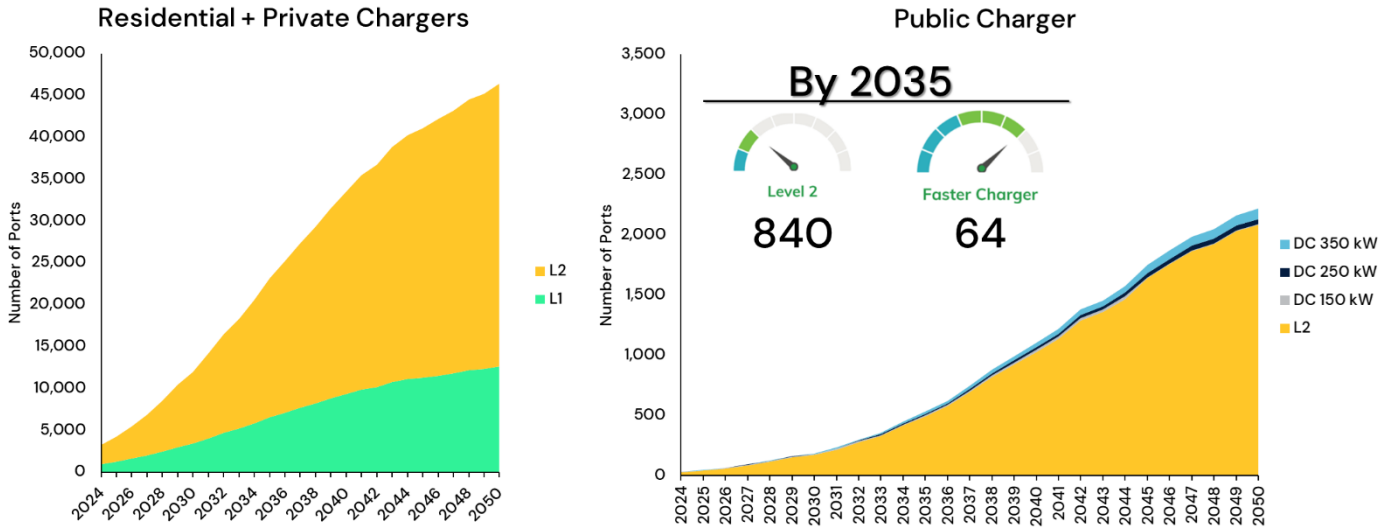
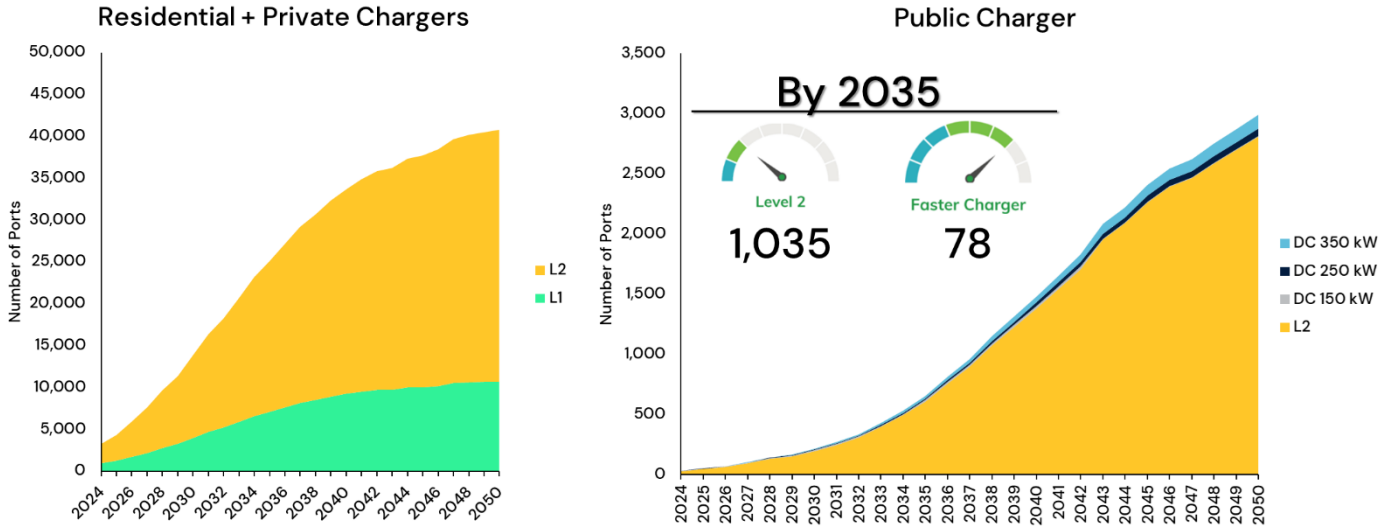


Figure 14. EV Infrastructure Needs Assessment – High Adoption Scenario



EV Charging Infrastructure Siting

Addressing the fast-growing demand of charging infrastructure requires a multifaceted approach that includes both public and workplace charging solutions. Public charging stations are essential for providing access to EV drivers who are on the go, allowing them to recharge their vehicles while visiting various destinations, whether for leisure or daily errands. This not only supports local tourism but also ensures that residents have convenient charging options throughout the region. On the other hand, workplace charging is necessary for daily commuters, offering a reliable place to charge during working hours and reducing the need for at-home charging infrastructure. It encourages employees to switch to EVs by providing the assurance that their vehicles can be fully charged during the day.

To maximize the effectiveness of both public and workplace charging, it is critical to focus on the proper siting of these chargers. This involves strategically locating charging stations based on factors such as high traffic areas, proximity to existing transportation infrastructure, and accessibility. Proper siting ensures that charging infrastructure is not only available but also optimally positioned to meet the needs of EV users, thereby significantly promoting the adoption of electric vehicles in the Tahoe Region.

This section is intended to describe the methodology deployed in developing a public and workplace EV charging siting analysis tool for the region. The tool follows a fundamental analysis framework to prioritize sites for the deployment of public and workplace charging stations. This framework consists of two main components: parcel level siting analysis and site exclusion. These two steps are briefly described below:

Parcel Level Siting Analysis

The parcel level siting analysis involves calculating a suitability score for each parcel to determine the optimal placement of charging infrastructure. This score is derived from a suite of different criteria, including the number of trips ending at the location, proximity to existing EV infrastructure, closeness to transit hubs, and whether the site falls within community priority zones, among other factors. This process, which is further explained in Section 2, produces a rank of sites based on their demand for EV charging.

Site Exclusion

After scoring each parcel in the region, sites deemed unsuitable for public charging are eliminated from consideration. This involves excluding parcels used exclusively for residential purposes, such as single-family units, apartments, and mobile home parks. Excluding these sites simplifies the selection process, as it narrows the focus to only those locations potentially suitable for public charging for further analysis.

Siting Analysis Methodology

Using a combination of geospatial and database tools, the team conducted a siting analysis to evaluate the suitability of each parcel in the TRPA region for EV charging. Placing a score on each parcel not only indicates which sites have the greatest projected need for charging, but also helps to combine with other priorities like providing charging access to community priority zones and encouraging multimodal trips. This section describes the methodology used for siting EV charging infrastructure for both public and workplace charging.

Goals

A numerical score is sought to objectively compare possible parcels for hosting pubic and workplace EV chargers. This score seeks to capture the demand for EV chargers to ensure that they are placed where they are needed most. It also seeks to deprioritize locations which already have access to chargers nearby. Altogether, the goals are as follows:

- Identify regions with a high volume of personal automotive trips, including private auto trips with non-home destinations for public EV charging and trips intended for work, to determine optimal locations for workplace chargers.
- Consider the types of trips that are most suitable for public charging needs (long-distance, non-home-based) and those that are relevant for workplace charging needs (long-distance, trip destination being work).
- Consider the length of time vehicles are parked for at each destination (under an hour is best suited for fast charging, over 2 hours is more conducive to level 2 charging).
- Identify areas where there is currently limited coverage by existing charging stations.
- Prioritize trips that originated within community priority zones.
- Prioritize areas where people could charge and ride transit, encouraging multi-modal transportation.

Variables Considered

As outlined in

Table 2 below, several data types and sources were used in building the scores for the siting analysis, including trip data for private auto trips, land use information, disadvantaged communities (DACs), locations of existing EV chargers, and transit stops.

Table 2. Description of Inputs Used in the Siting Analysis for Light-Duty Vehicles

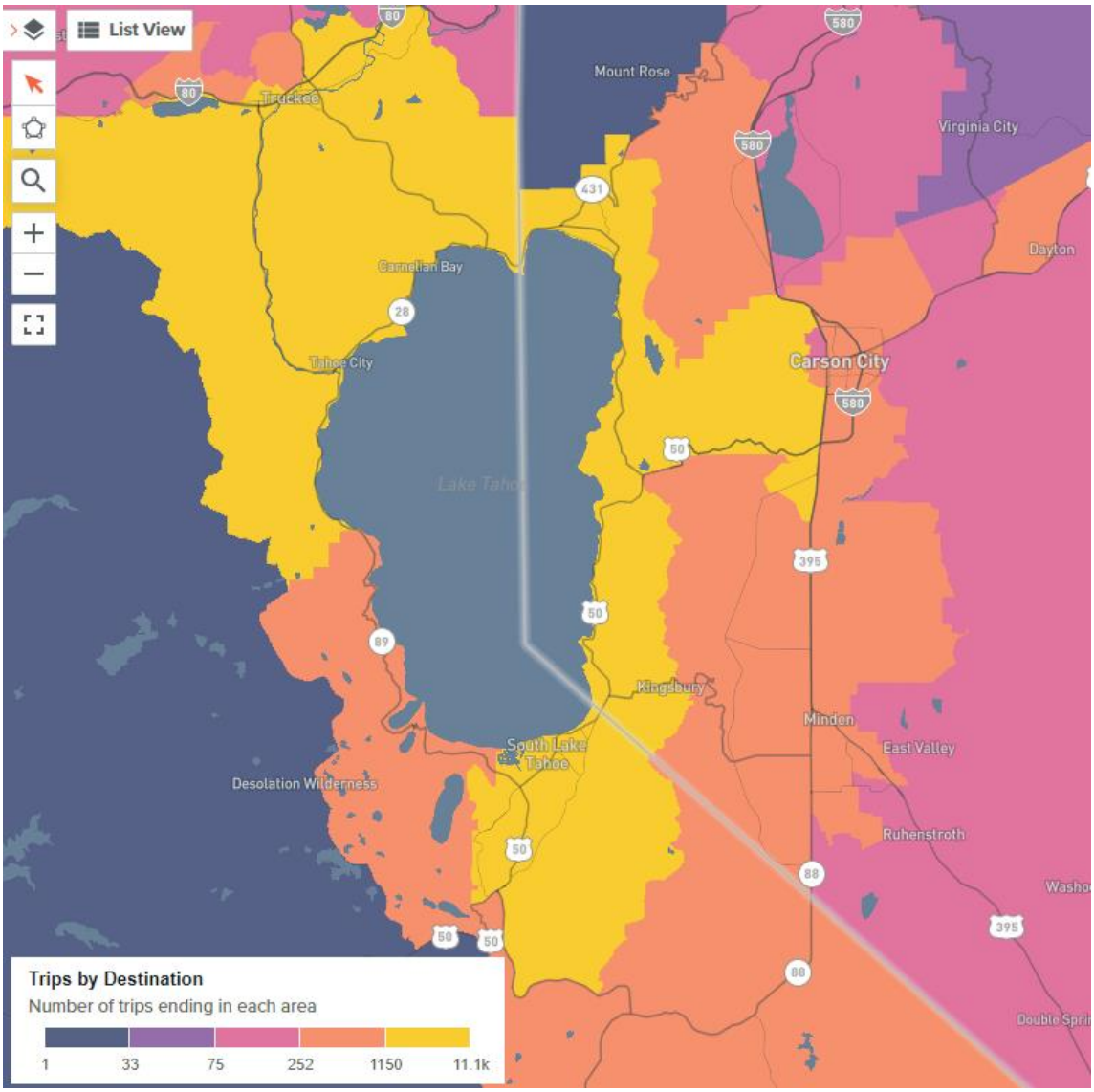
Information Type	Source	How it is used
Trip data (private auto trips)	Replica[9]	Generate travel demand scores
Land use	TRPA Open Data	Exclusion of sites solely used for housing and wilderness

[9] https://www.replicahq.com/

Information Type	Source	How it is used
Disadvantaged communities	TRPA Open Data	Boosting scores of sites inside of Community Priority Zones
EV charger locations	AFDC database[1]	Decreasing scores of sites < ¼ mi away from existing chargers, both L2 and DCFC
Tahoe Basin bus stops	TRPA Open Data	Boosting scores of sites within ½ mi of transit hubs
Parcels	TRPA Internal Layer	To define the areas of parcels

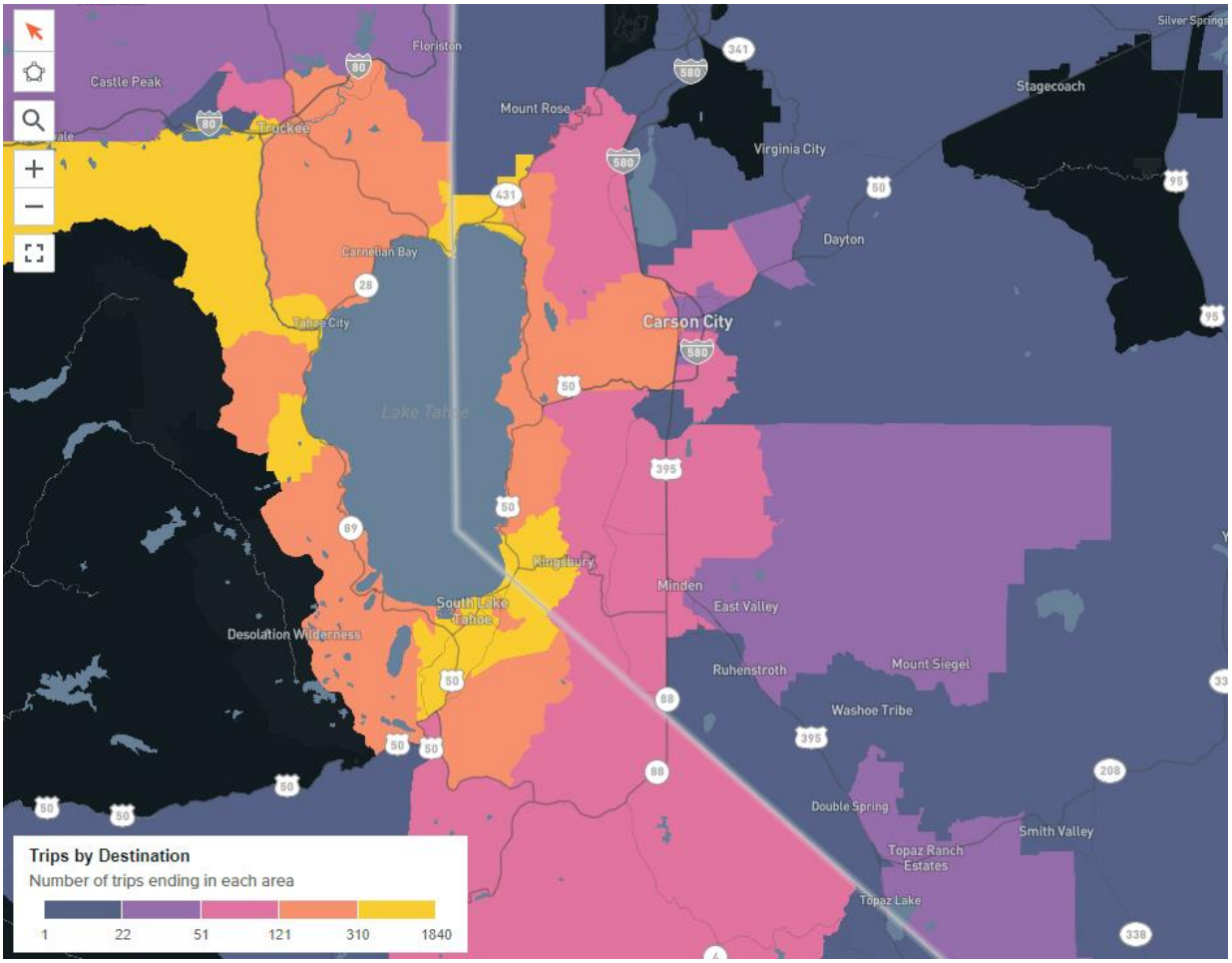
Figure 15 shows trip data (both home and non-home trips) retrieved from Replica. This data lists every trip taken by car which either starts or ends in the Tahoe Region in Fall 2023 on a typical Thursday. It includes the land use in which each trip started and ended, trip purpose, trip length and the trip start and end times. It also gives detailed information about the driver such as their home zip code, estimated household income, estimated number of household vehicles and their estimated employment status.

Figure 15. Trip Demand by Destination from the Replica Platform (Private Auto Trips)



While for the public EV charger siting analysis, all non-home trips were considered to ensure a comprehensive understanding of the demand for public charging stations; for workplace charging, the project team narrowed the scope to include only trips specifically intended for work, also known as "workplace" trips. Figure 16 illustrates the distribution of these workplace trips by Census Block Group (CBG) across the region.

Figure 16. Trip Demand by Destination from the Replica Platform (Workplace Trips)



To prioritize siting chargers in areas where they are needed, our siting analysis includes an inventory of every existing EV charging station in the Tahoe Basin, as shown in

Figure 17. This data was obtained by querying the AFDC Alternative Fueling Station Locator for every EV charger (both Level 2 chargers and DCFCs) within the zip codes that cover TRPA's boundaries. Consequently, it includes many chargers that fall outside of the boundary as well. These chargers located beyond TRPA's boundary are also incorporated into the analysis to assess the proximity to existing charging stations and identify potential service gaps.

As shown in Figure 18, TRPA's Community Priority Zones (CPZ) are used to determine which areas are part of disadvantaged communities in the Tahoe Basin. These zones were created specifically by TRPA recognizing the unique challenges for the region with local expertise. Notably, the TRPA DAC designation differs significantly from the definition used by

CalEnviroScreen[10] or the Justice40[11] initiative in identifying CPZs for federal spending. The California definition is quite strict and does not identify any DACs in the Tahoe Region. The Justice40 definition is broader and overlaps with some TRPA CPZs. To receive the National Environmental Policy Act (NEPA) funding, it may be worthwhile to consider these Justice 40 locations in addition to the TRPA CPZs in public charger siting.

Figure 17. Locations of Existing EV Chargers in the Tahoe Basin

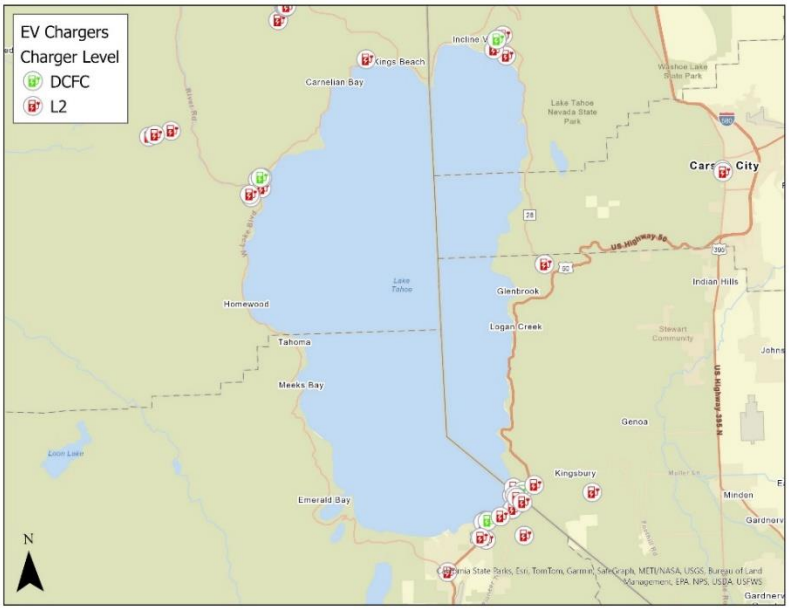


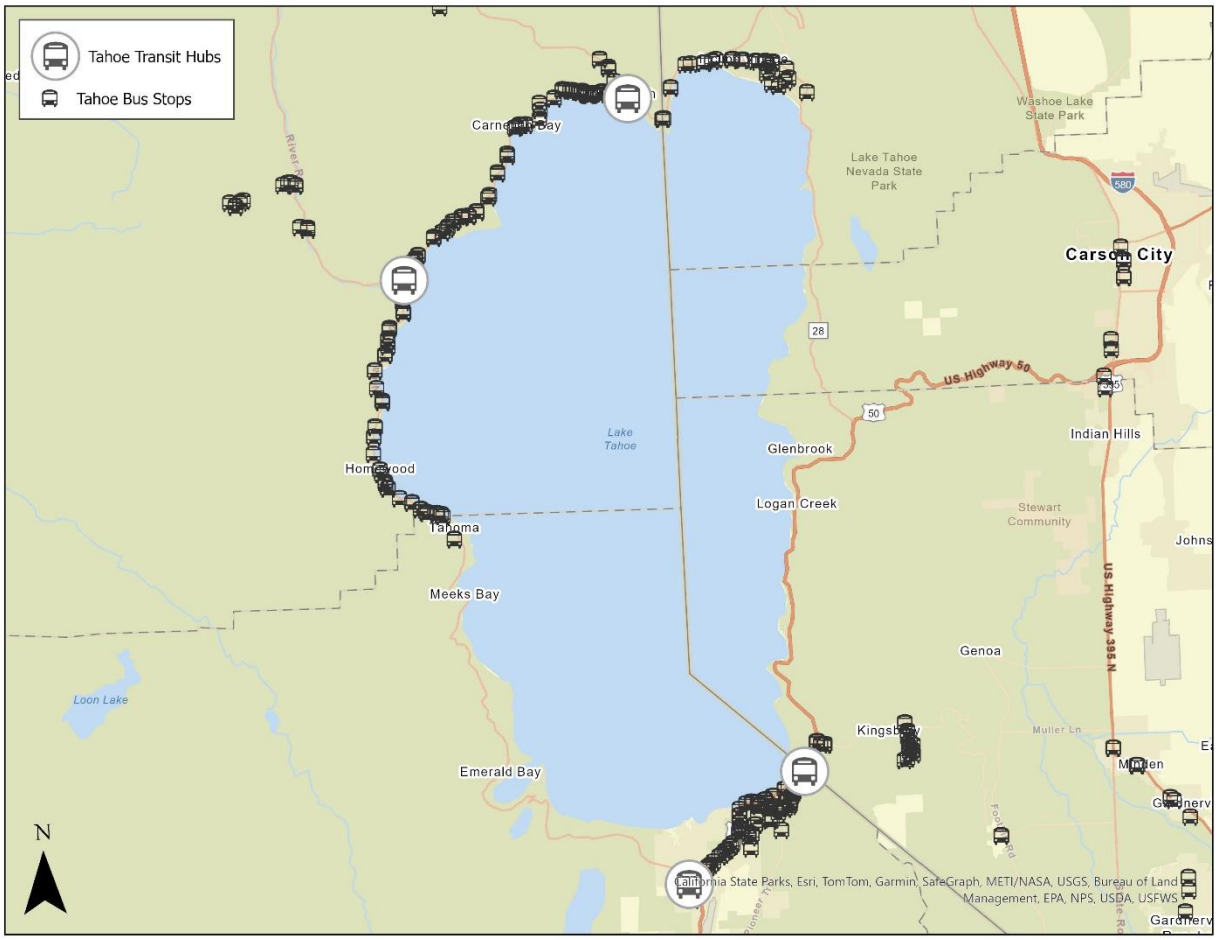
Figure 18. Locations of Community Priority Zones (per TRPA)

[10] https://oehha.ca.gov/calenviroscreen
[11] https://www.transportation.gov/equity-Justice40.

To encourage siting chargers near high-quality transit locations where multiple transit lines converge, were identified as transit hubs (refer to

Figure 19) and received an additional point in the site scoring. These hubs have the potential to serve as park-and-ride facilities. This analysis identified four key locations: the Stateline Transit Center, the South Y Transit Center, the Tahoe City Transit Center, and the King's Beach Recreation Area.

Figure 19. Tahoe Basin Transit Stops

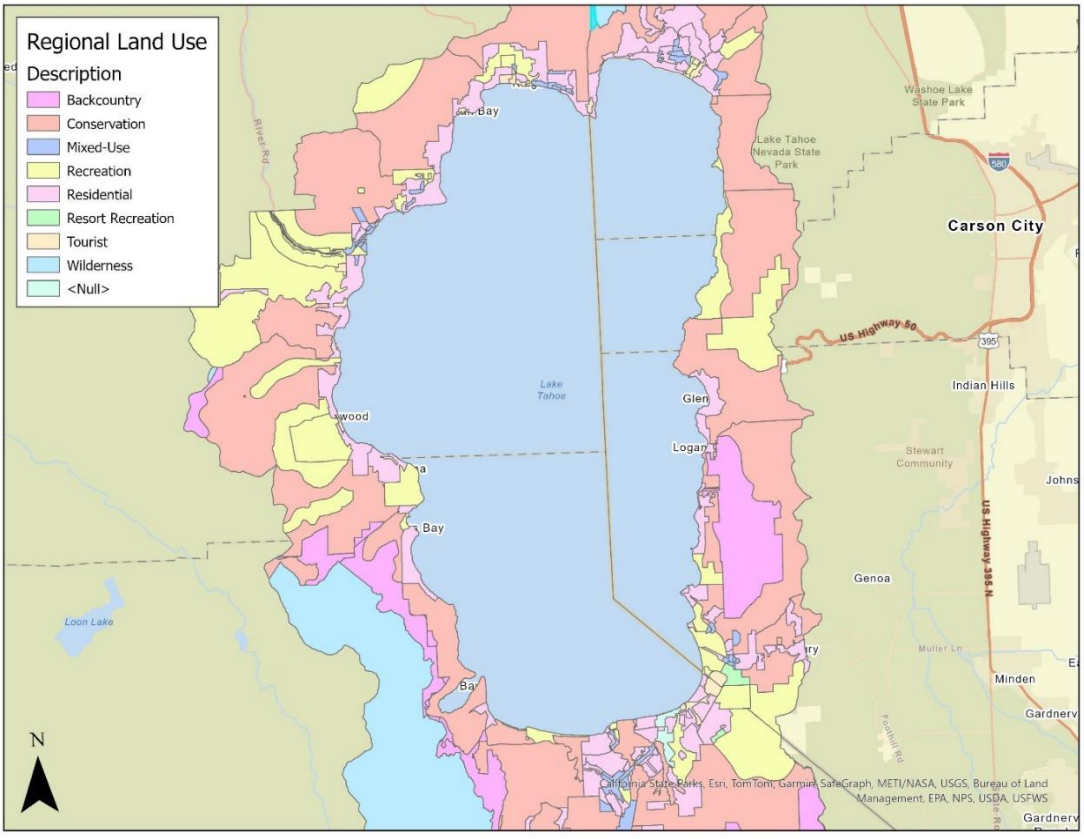


Considering that a significant fraction of the land area in the TRPA region is zoned for residential use only, the project team excluded those parcels from the analysis (most of the vehicle trips ending in those sites are "home" trips which are not suitable for use of public charging infrastructure). Thus, our site exclusion process takes information on zoning and land use as shown in Figure 20 and uses that as criteria to remove sites from consideration. Any site exclusively zoned for residential or multifamily development is excluded, leaving behind sites designated for uses like commercial, retail, industrial, public facilities, parks, and even vacant lots. While some of these sites might not be the optimal choices, they are retained on the final map of candidate locations as potential options worth considering. The charging demands for residents in these excluded areas will also need to be met, especially for the large apartment buildings and condominium complexes across the region. Currently, several

tax incentives and rebates exist to help facilitate charger installation in multi-family housing such as the Communities In Charge program[12] (for multifamily housings in California) or the Alternative Fuel Infrastructure Tax Credit[13]. Nonetheless, it is in the region's best interest to support charger rollout in these complexes because in most cases residents have no access to at-home charging.

We also note that charging at single family residences is critical for improving adoption of EVs across the region. Currently, many EV purchases come with rebates for charger installation, which is more than sufficient in most cases to upgrade residential electrical access.[14] Moreover, TRPA can help provide resources to dealers and buyers to ensure that these are fully taken advantage of. For example, Liberty Energy offers incentives for both residential and commercial customers[15]. For residential installations, rebates go up to $1,500, with a set of detailed requirements that applicants must comply with. Commercial installations are eligible for $2,500 of funding but are only available to customers on an A1 or A1-Time of Use (TOU) rate. Thus, although these locations will not be considered for public charging, they shall remain a focus of the region moving forward.

Figure 20. Land Use Map for the Tahoe Basin



[12] https://thecommunitiesincharge.org/
[13] https://www.irs.gov/credits-deductions/alternative-fuel-vehicle-refueling-property-credit#who
[14] https://afdc.energy.gov/laws/state_summary?state=CA&technologies=ELEC,PHEV&counties=16,40
[15] https://california.libertyutilities.com/uploads/Liberty%20Drive%20Program%20Handbook.pdf

Overview of Scoring Metrics

In conducting the siting analysis, each CBG was scored based on the trip attributes that end within that CBG using an ArcGIS Python script. For example, a CBG with higher numbers of trips not ending at home (whether single-residence or multi-family) receives a higher score since it is more likely that there will be a need for a public EV charging infrastructure within that CBG as opposed to another CBG where majority of trips end at a home location. In another example, a CBG with a higher fraction of long-distance trips is more likely in need of charging stations.

Note that the deployment of workplace charging infrastructure for light-duty vehicles predominantly focuses on Level 2 chargers, as employees typically remain at their workplace for approximately eight hours. This approach is advantageous because Level 2 chargers are much less expensive to deploy and shift power demand to the middle of the day when solar power is peaking and wholesale electricity rates are at their lowest.

Following this analogy, each CBG[16] is scored based on the following metrics:

Trip Purpose – Number of trips with destination not being home

From the Replica trip data, we counted the number of trips ending at each CBG where the trip destination was not home. While all of these non-home trips are being used for the public EV charger siting analysis, only trips specifically intended for work (with the trip destination being "work") are being utilized for the workplace EV charger siting analysis. Once the number of trips per CBG is determined, we then normalize the trips using the trip numbers from the CBGs with maximum number of trips (e.g., if the maximum number of trips is 100, then we divide the trip numbers for all CBG by 100). This way all CBG will be scored between 0 to 1.

Trip Length – Number of long-distance trips (≥20 miles)

From the Replica trip data, we count the number of trips ending at each CBG with trip length greater than 20 miles. Then, we normalize the trips using the methodology described earlier.

Dwelling Time Between 30 and 60 Minutes (Prioritizing DCFC)

First, we calculate the dwelling time for each trip by analyzing consecutive trips from a single individual and determining the time elapsed between the end of one trip and the beginning of the next. Subsequently, we tally the number of trips concluding at each CBG where the dwelling time ranges from 30 to 60 minutes. Finally, these trips are normalized using the previously described methodology.

Dwelling Time Between 60 and 120 Minutes

Similarly, we calculate the dwelling time for each trip by examining consecutive trips from an individual and measuring the duration between the end of one trip and the start of the next. We then count the number of trips that end at each CBG with a dwelling time of 60 to 120 minutes. As before, these trips are normalized according to the earlier outlined methodology.

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[16]The scoring methodology was refined to restrict the assessment to CBGs specifically within the City boundaries

Dwelling time greater than 120 min (prioritizing L2)

We also count the number of trips ending at each CBG with dwelling time greater than 120 min. Then, we normalize the trips using the same methodology.

Prioritizing trips to/from Community Priority Zones

From the Replica demand data, we count the number of trips ending at each CBG with an origin CBG being within a community priority zone.

Scenario Scoring

After determining scores for all six metrics, a weighted average score is computed considering the importance of each criterion (weight) under different scenarios. The total value of scenario scoring is up to 10, indicating that locations meeting this score are considered the most favorable. Scenario 1, shown in Table 3, considers locations with long dwell times, long and non-home-based trips well suited for Level 2 chargers. Note that one column represents the weights for public charging and the other column illustrates weight for workplace charging.

Table 3. Scenario 1 – Prioritizing Level 2 Chargers

Metric	Weight for Public Charging	Weight for Workplace Charging
Trip Purpose	30	30
Trip Length	20	20
Dwelling 30-60	0	0
Dwelling 60-120	10	0
Dwelling >120	40	50
Community Priority Zone	0	0
Total	100	100

Scenario 2, shown in Table 4, identifies locations well suited for DCFCs by putting greater emphasis on longer trips along with shorter dwell times where slower charging would not be convenient.

Table 4. Scenario 2 – Prioritizing DCFC Chargers

Metric	Weight for Public Charging	Weight for Workplace Charging
Trip Purpose	10	10
Trip Length	50	50
Dwelling 30-60	40	40
Dwelling 60-120	0	0
Dwelling >120	0	0
Community Priority Zone	0	0
Total	100	100

Scenario 3, shown in Table 5, identifies appropriate locations for charging infrastructure with a greater equity emphasis by more heavily weighting trips taken by drivers living in community priority zones. Note that while the focus for public chargers is on DCFC chargers, for workplace charging, the weights are adjusted to determine sites more suitable for Level 2 charging. Ultimately, our findings indicate a consensus among all three scores on the suitability of sites, as these locations are frequented for a diverse range of trip lengths and types. For workplace

scoring, we see that hotspot commercial or retail locations like the Incline Village Commercial district tend to score higher in workplace charging scenarios than in public charging scenarios.

Table 5. Scenario 3 – Prioritizing DCFC Chargers with Equity Focus

Metric	Weight for Public Charging	Weight for Workplace Charging
Trip Purpose	0	0
Trip Length	30	20
Dwelling 30-60	30	0
Dwelling 60-120	0	
Dwelling >120	0	40
Community Priority Zone	40	40
Total	100	100

Parcel Level Factors

Additional bonus points are added onto or subtracted from the score to differentiate parcels within the same block group, including:

- +1 for within ½ mile of a transit hub (3 or more bus lines coming together)
- 0 to -2 for Level 2 charging within ¼ mile
- 0 to -2 for DCFC within ¼ mile
- +1 for within Community Priority Zone (TRPA definition)

These factors serve an important purpose in reducing the scores of sites which already have access to nearby EV charging. They also give added weight to sites which meet basic transportation priorities like increasing the likelihood of multi-modal trips and equitable distribution of chargers within DACs.

Site Exclusion Methodology

The site exclusion process aimed to remove all sites where the deployment of public or workplace charging is not feasible. This includes residential parcels as well as parcels identified as being within wilderness areas, which should not be considered for the location of public or workplace chargers. By excluding these areas, the team intended to focus on sites that would be more practical and beneficial for charging infrastructure deployment. This process was done in ArcGIS using overlays from the land use layer. After significant exploration of the parcels and the zoning layer, the filters shown in Table 6 were used to exclude parcels for both public and workplace EV charging siting.

Table 6. Filters for Excluding Sites

Variable Name	Source Layer	Excluded Tags
Existing Land Use	TRPA Parcel Layer	Condominium, Condominium Common Area, Multi-Family Residential, Single Family Residential, Open Space without access to a road or parking

However, during this process, the project team realized that certain parcels, while falling within open space and wilderness areas, are publicly accessible. These include trailheads and some

parcels that the TRPA has identified as publicly accessible. As a result, these parcels were not excluded from the analysis, given the possibility of establishing charging infrastructure for them. The inclusion of these sites recognizes their potential for supporting public access and recreational activities, making them suitable for future charging infrastructure development. While acknowledging the importance of grid capacity, it is currently not factored into this report's analysis. Future evaluations could incorporate this criterion if additional data becomes available. For example, each property must already have a connection to the utility grid or be in proximity to existing feeders. Because the Tahoe Region is served by multiple utilities, acquiring relevant data becomes more complicated.

Results

Site Analysis Results for Public Charging

After applying our siting methodology for public chargers, we summarize the results by scenario in Figure 21 through Figure 23. As we expected, the sites with the highest scores are found in South Lake Tahoe outside of the quarter-mile radius of existing EV chargers. Several high-scoring sites are also found in the commercial district of Incline Village and in the downtown areas of Tahoe City. This trend persists across all three of the scenarios, although there are a few noteworthy trends to point out. Areas like the beach parking at Kings Beach tend to score better for Scenario 1 (level 2 charging) because a higher fraction of the trips have longer dwell times. Also – we note that there are not very many sites that meet our inclusion criteria for EV siting on the east side of Lake Tahoe because the land use is primarily Open Space or Residential, with far fewer labeled as Commercial, Recreation or Tourist Accommodation which might serve as good hosts for chargers. That said, we also note that this region has far lower trip demand than the other hotspots and as such probably has a much lower demand for charging. Additionally, Scenario 3 (Equity-focused DCFCs) seems to favor those locations near the Community Priority Zones and nearby attractors like the South Lake Tahoe Raley's over those like the Stateline casinos. This is consistent with the fact that residents in these areas are less likely to take trips to tourist-focused destinations.

Figure 21. Results of Parcel Scoring – Scenario 1 Score
(a higher score indicates a more favorable location based on the specified criteria)

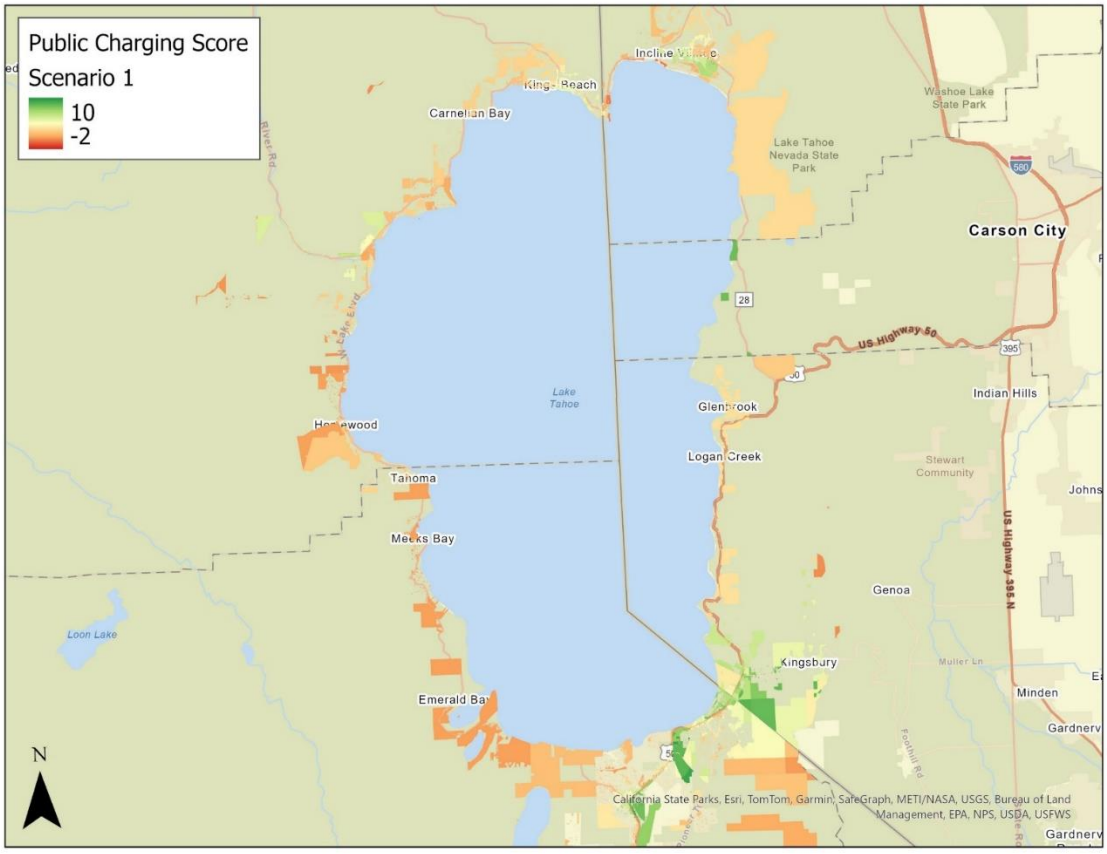


Figure 22. Results of Parcel Scoring – Scenario 2 Score
(a higher score indicates a more favorable location based on the specified criteria)

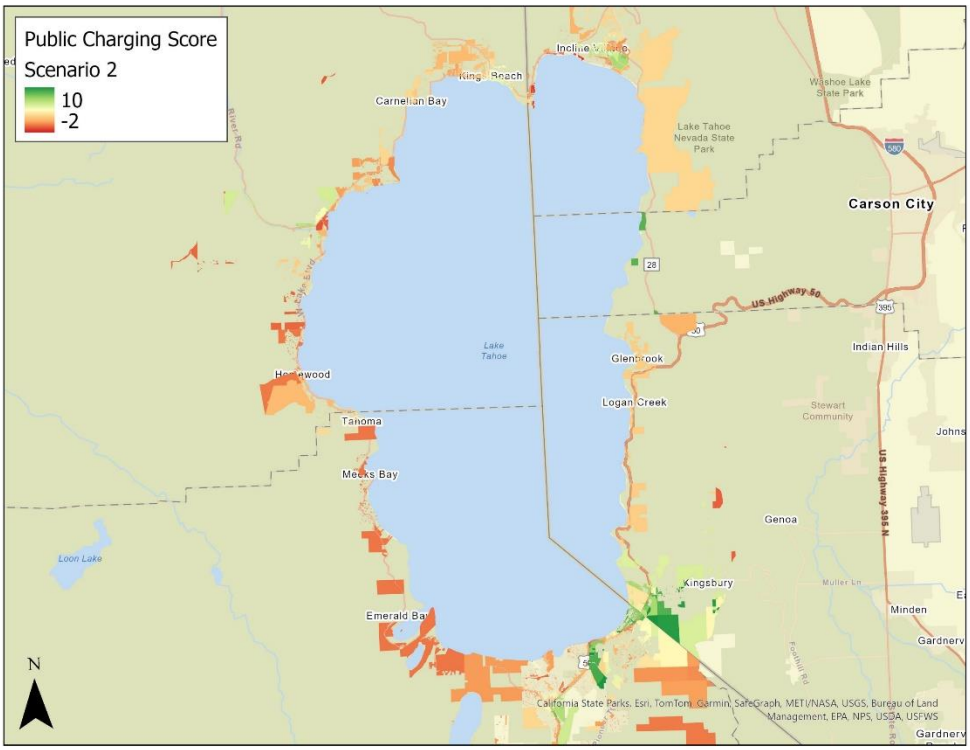
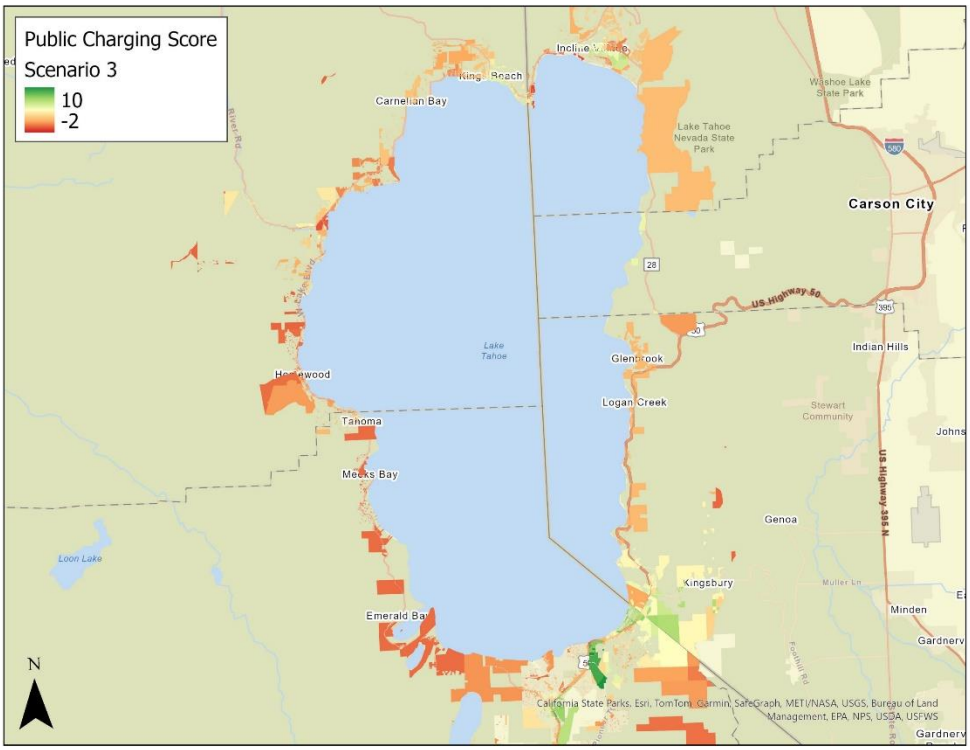


Figure 23. Results of Parcel Scoring – Scenario 3 Score
(a higher score indicates a more favorable location based on the specified criteria)



Site Analysis Results for Workplace Charging

Generally, sites within major cities in the region, such as South Lake Tahoe, Tahoe City, and Incline Village, received higher scores. Figure 24 through Figure 26 display the scores for each of the three scenarios. This visualization clearly shows that several areas with high charging demand currently lack chargers. Additionally, similar to public charging scenarios, the east side of the region has a scarcity of commercial or retail sites suitable for charging, resulting in fewer options. Nonetheless, these areas experience significantly fewer work-based trips. As noted earlier, Tahoe City and Incline Village received higher scores under workplace scenarios compared to public EV charging scenarios. This is likely due to the higher fraction of work trips ending in these locations.

Figure 24. Results of Parcel Scoring – Scenario 4 Score
(a higher score indicates a more favorable location based on the specified criteria)

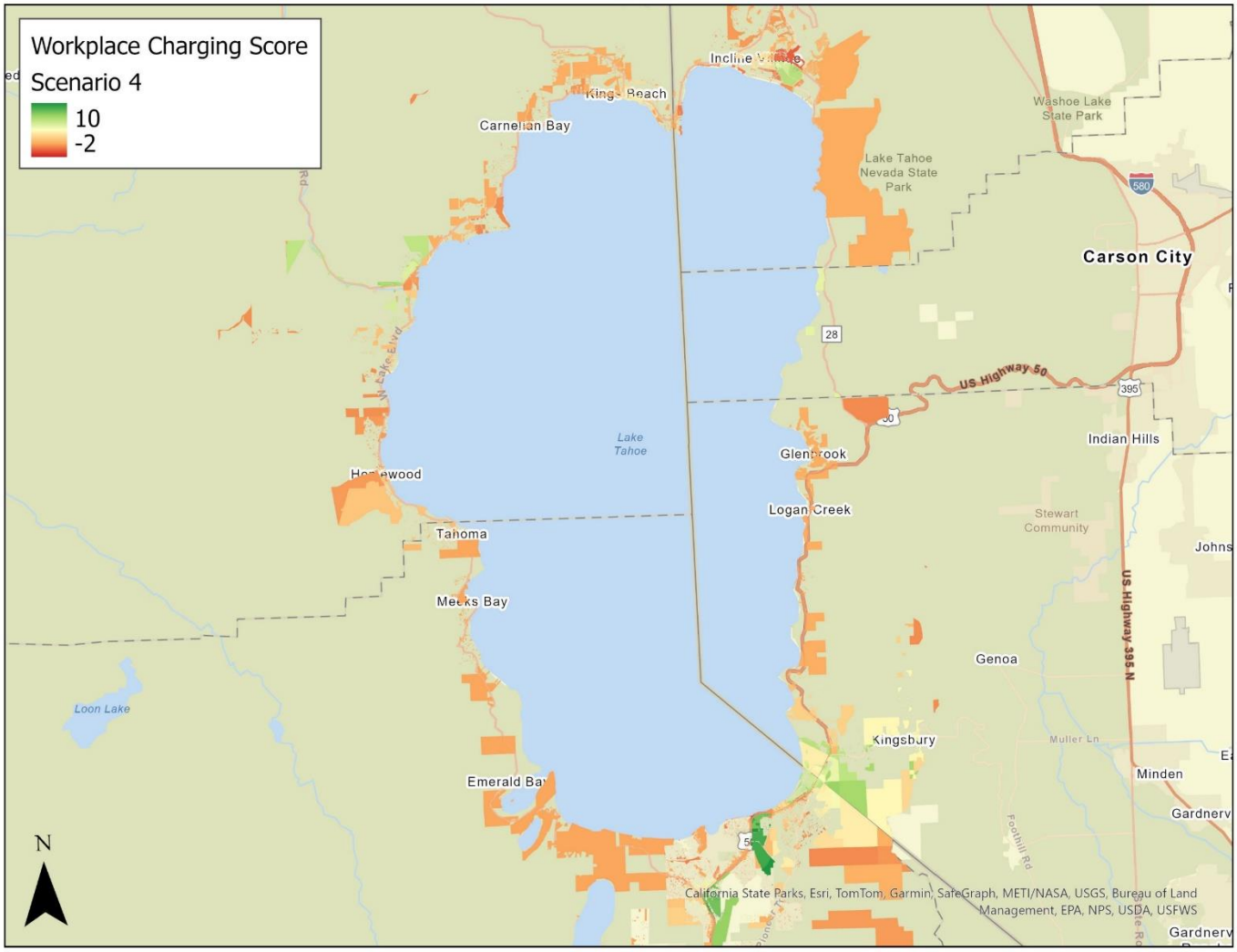


Figure 25. Results of Parcel Scoring – Scenario 5 Score
(a higher score indicates a more favorable location based on the specified criteria)

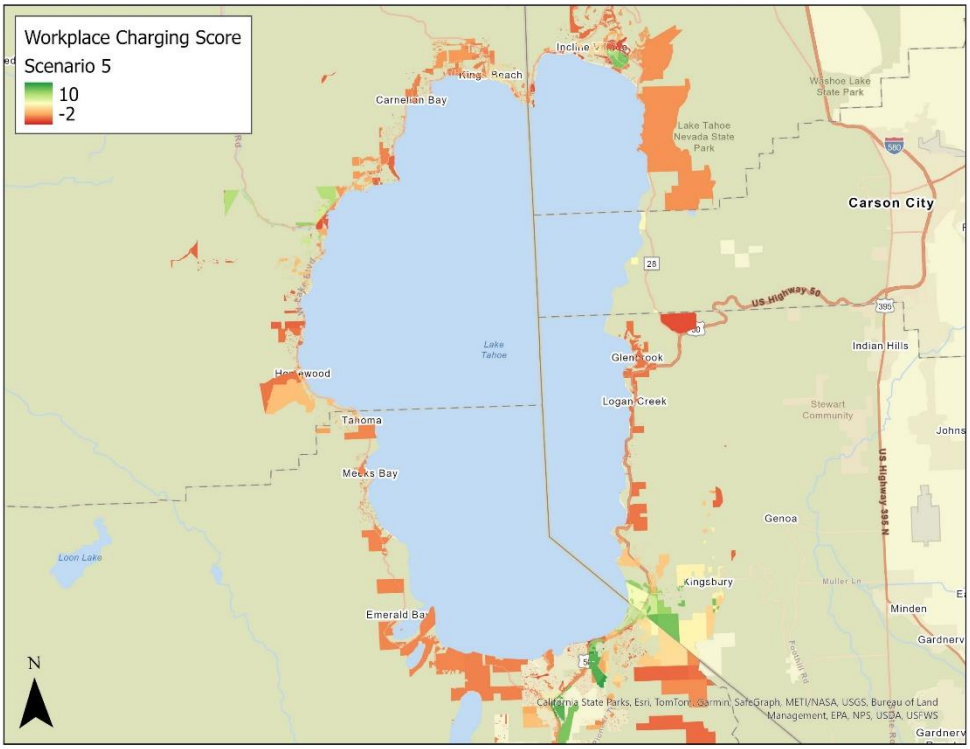
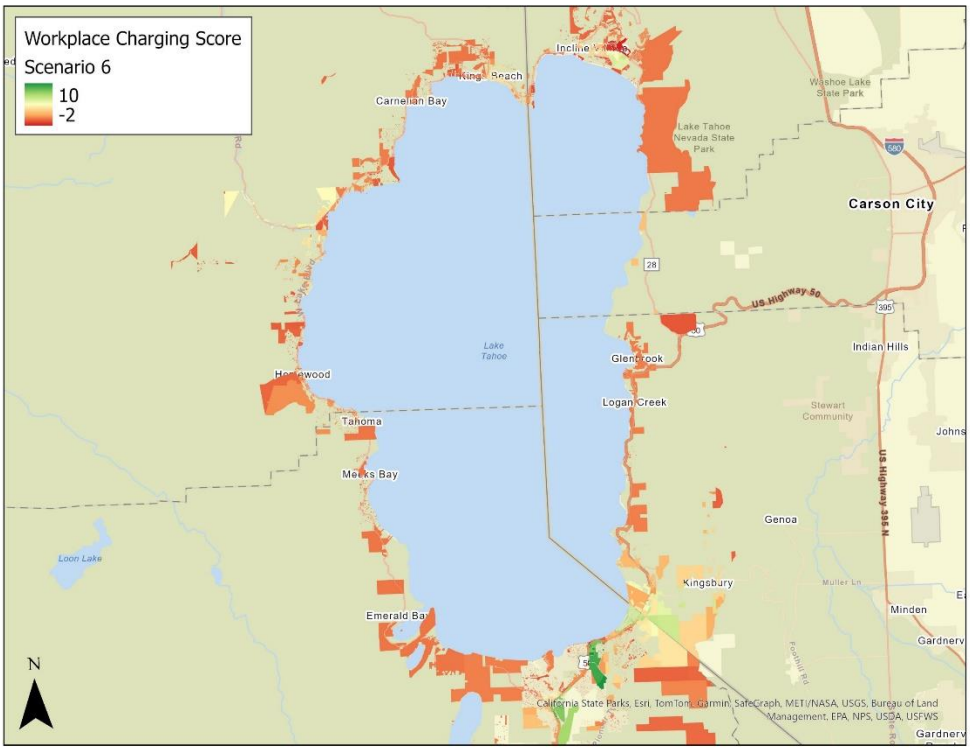


Figure 26. Results of Parcel Scoring – Scenario 6 Score
(a higher score indicates a more favorable location based on the specified criteria)



E-Mobility Whitepaper

In addition to assessing EV adoption trends and understanding infrastructure deployment needs, this report also includes a white paper on e-bike and e-mobility charging, adoption, and best practices. It reviews the current micromobility landscape in the Lake Tahoe Basin and offers recommendations for improving and expanding existing programs. As part of this white paper, the project team conducted a detailed analysis of data from Lime and Bird, the two e-mobility companies currently operating in the Tahoe Region. Based on this data analysis, the project team provided a set of recommendations to help the region accelerate the adoption of these clean and sustainable mobility options.

History of e-mobility in Tahoe Region

The use of micromobility in the Tahoe Region dates back to 2017, when the League to Save Lake Tahoe established a dockless bikeshare pilot program in South Lake Tahoe for July through October.[17] The program was just the 3rd city for newly founded Lime, and due to the early nature of this program, there was no age restriction on ridership. This was a highly successful program, with the League reporting that ridership per bike for the fleet of 200 was higher than in any other US city in July. To attract ridership, pricing was set at $1 for the first 30 minutes and an additional $1 for the next 30 minutes.[18] In the end, the program led to:

- 12,731 trips
- 5,953 total riders
- 8.73 minutes riding/trip
- 1.11 miles/trip
- 9,925 miles traveled
- 6,617 VMT displaced (est.)

For the 2018 season, Lime returned for its first full season, introducing scooters to the program. The new scooter program used a different pricing model - $1 to unlock and $0.15 per minute afterward. Again, the program was sponsored by the League to Save Lake Tahoe, now with 530 total vehicles. This time, to incentivize locals to charge the new scooters and electric bikes, Lime established a program called “Lime Juicers” to pay Tahoe locals to charge the vehicles. They also instituted an age restriction to ensure scooter riders were 18 years or older. By September 2018, Lime reported over 100K scooter trips and 50K bike trips from May 21st, representing a 10-fold increase in trips from the previous year. Trip lengths increased slightly, averaging 11 minutes for scooter and bike trips, 0.78 mi for bike trips and 1.52 mi for scooter trips.

The program experienced its first major shift in 2019, as bikes were removed and the City of South Lake Tahoe signed a one-year contract with Lime, with an anticipated follow-on

[17] https://www.keeptahoeblue.org/news/south-tahoe-bike-share-pilot-by-the-numbers/
[18] http://southtahoenow.com/story/07/11/2017/new-bike-ride-share-program-start-south-lake-tahoe-saturday

agreement for future years. This agreement had several tenets which would inform the program as it exists today.

- Lime could use City rights-of-way.
- Lime could only use scooters unless approved by the City.
- Scooters could be parked on sidewalks or other "hard surface", so long as they provide 3 ft of walkway per the ADA, and could not impede access to ADA parking, street furniture, curb ramps, entryways and driveways, sidewalk cafes, transit zones, loading zones and landscaping beds.
- Scooters violating these rules must be moved within 4 hours of the City notice.
- The City may remove a scooter that "creates a hazard", and if so, may charge Lime a $35 relocation fee.
- Lime to institute geo-fencing to help identify preferred parking locations and limit access to Heavenly Village and Lakeview Commons.
- Program was limited to 550 scooters, unless an increase was agreed upon by the City Manager.
- Each trip will collect a $0.05 fee.
- Lime will provide an API to trip data in the Mobility Data Specification (MDS) and shall administer a survey asking if riders are City residents or visitors, with results provided at the end of 2017.
- The agreement may be extended after the one-year term.

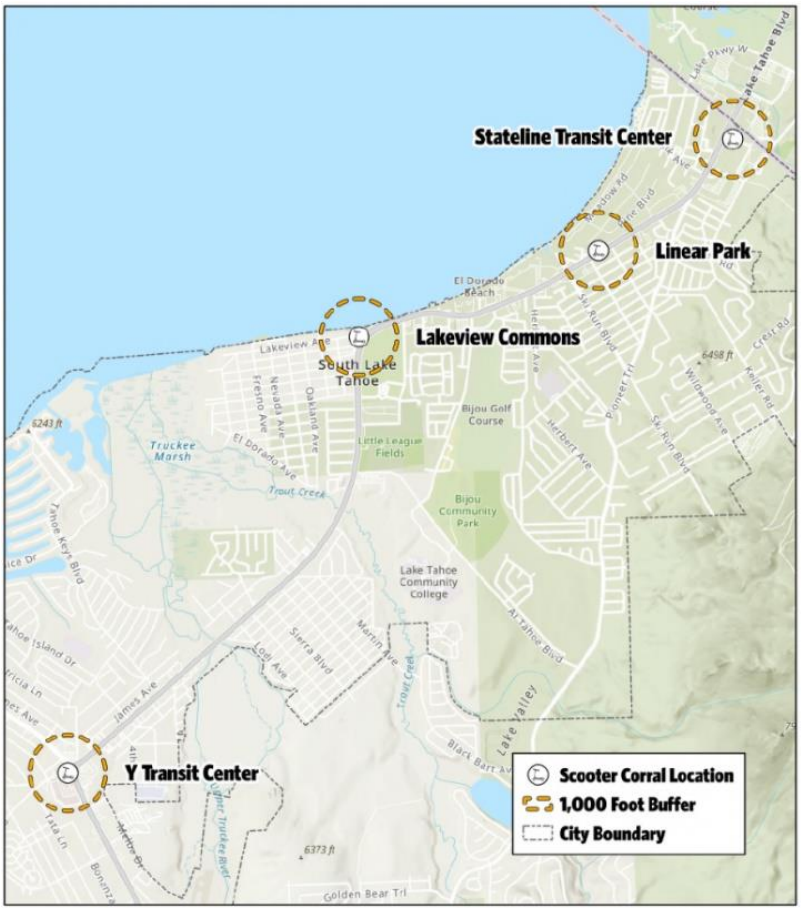
After 2 major injuries to children in 2019 (an 11-year-old girl and a 13-year-old boy), the South Lake Police Department (PD) advocated in October 2019 for the development of an electronic shared mobility ordinance to formalize a set of rules to prioritize safety and accountability for shared mobility companies.[19] Under Ordinance 1140, South Lake Tahoe established formal regulations on operators and riders of shared mobility devices within the City.[20] Among these, the ordinance gives power to the Chief of Police to establish parking zones, no-ride zones and restricted speed zones. Of these, the ordinance specifically restricts access to Heavenly Village, and restricts vehicles from being parked on Class I or II bikeways. In the ordinance, riders can also now be fined up to $100 for violating the rules. Notably, the ordinance does not impose any specific requirements related to equity for operators such as having a low-income rider program, collecting data related to equity measures, offering a smartphone alternative, a cash payment option or requiring any equity evaluations or reporting. It only requires operators to consent to share anonymized data with the City on the trips of their fleet within the City, including the zip code of each ride, without any other specifications related to the data they provide.

This ordinance also required operators to apply for a permit to operate, with a maximum of 500 scooters per operator and 1000 scooters total within the City. It also added a new fee of $75 per device, and a requirement for the operator to insure the City for up to $2 million per occurrence to limit the City's liability against injury. Following existing precedent, the ordinance formalizes the "season" of e-scooter use from May 1st to October 31st. These rules

[19] https://southtahoenow.com/story/10/28/2019/south-lake-tahoe-create-ordinance-electric-scooters
[20] https://www.codepublishing.com/CA/SouthLakeTahoe/#!/html/SouthLakeTahoe04/SouthLakeTahoe04185.html

were later amended in March 2024 through Ordinance 1184 to add requirements for scooters to be parked in "corrals" if one is nearby. These proposed corral locations are shown below in Figure 27.

Figure 27: Proposed Scooter Corral Locations



Despite these new rules, Lime formally protested the fees at the start of the 2020 season due to uncertainty around COVID and its ridership effects as well as the later deployment in July.[21] The City agreed to waive the fee to avoid losing the service altogether, instead agreeing to a $0.10 per ride charge. Despite the shorter season, ridership increased by 23 percent in 2020 with 50 fewer scooters than in 2019 (due to the new regulation setting 500 as the maximum per operator).[22] In total, nearly 200,000 trips were taken, replacing nearly 50,000 car trips. This led to $18,651 being collected in fees.[23] In 2021, Lime paid the full fee, amounting to $37,500 for the year. Additionally, Bird submitted its permit application with the City in 2021, opening the market to increased competition for the first time.[24] The application was approved in 2021, so for the first time, both Lime and Bird brought 500 scooters each to the City of South Lake Tahoe in 2022. This generated $75,000 for the City in permitting fees for

[21] https://www.southtahoenow.com/story/06/25/2020/lime-scooters-return-south-lake-tahoe-july-1
[22] https://www.tahoedailytribune.com/news/limes-ridership-was-up-in-south-lake-tahoe-this-summer/
[23] https://southtahoenow.com/story/05/25/2021/lime-scooters-return-south-lake-tahoe-summer
[24] https://southtahoenow.com/story/07/30/2021/lime-scooters-face-new-competition-south-lake-tahoe-bird

both 2022 and 2023.[25] It is expected that both Bird and Lime will generate this same revenue for 2024.

Overview of Bird data

Unlike Lime, Bird did not share detailed trip data for its program duration. But Bird's data from its first two years of operations had many items that the Lime's trip data lacked, such as information on complaints, injuries and how Bird's equity program was used in the South Lake Tahoe system.

Equity program

Bird provides a 50 percent discount to riders who are elderly or have low income through their national equity program (called Community Pricing). Eligible riders must demonstrate proof of age or participation in a welfare program such as SNAP, Medicaid or WIC. Based on the data provided to TPRA by Bird, this program does not appear to be particularly well utilized in the Tahoe Region, perhaps because potential users do not know about it, or because the discounts offered are not steep enough. More information about this program is shown in Table 7 below.

Table 7: Community Pricing Plan Usage in South Lake Tahoe[26]

Year	Total Community Plan Users	New Community Plan Users	Total Community Plan Trips	Community Plan Trips per user
2022	12	9	27	0
2023	6	3	7	0

Purchase characteristics

Data shared by Bird for both the 2022 and 2023 seasons show relative agreement on the average cost of scooter trips. As shown in Table 8, trips taken by Bird are notably more expensive than taking the bus (which is now free to users Basin-wide) for such a short distance, but they compare favorably with other alternatives such as Uber, Lyft, or taxis. A rider who chose the community plan should anticipate the average cost to be around $4 per trip, but even though it is closer, it is still pricier than riding the bus.

Table 8: Average pricing for Bird scooter trips in South Lake Tahoe[26]

Year	Average Trip Cost	Average Cost per Mile
2022	$7.73	$5.72
2023	$7.55	$5.63

Injuries & Complaints

As requested by the City, Bird also keeps track of collision data as detected and reported by users. It also tracks formal complaints submitted related to Bird scooters. In 2022, there were 18 incident reports submitted, which dropped significantly to only 10 in the 2023 program year.[26] The information shared for collisions and safety is quite vague, but it is nonetheless a

[25] https://southtahoenow.com/story/05/26/2022/two-companies-bringing-1000-electric-scooters-south-lake-tahoe-summer
[26] Based on Bird's Shared Micro-Mobility Permit Report published in 2022 and 2023, respectively. Reports were shared with the project team by TRPA directly.

useful reference point for comparing the program across years. It is not clear what the threshold for an incident is – whether it requires there to be an injury, where the reports come from (PD or the Mobile App itself) and what the resulting resolution of complaints was. More detailed data related to the severity of collisions or injuries would allow the City to better differentiate between minor issues and serious collisions that could result in death or disability. It would also allow the City to have a stronger basis in making signage, striping, and other infrastructure changes. Bird shares their complaint data by month, as shown in Table 9. It should be noted that it is quite suspicious that the complaint counts match exactly between 2022 and 2023. This likely indicates a mistake in reporting by the company for one of the two seasons. The frequency of these complaints seems to correspond to the timing of the peak season in June, July and August. This general trend aligns with scooter ridership data shared by Lime reported further into this white paper. We would recommend that the City reach out to Bird for further clarity on this data and to get access to the detailed injury data from both 2022 and 2023 if possible.

Table 9: Complaints to Bird by month (injuries are not included)[26]

Month	Complaints in 2022	Complaints in 2023
May	29	29
June	55	55
July	85	85
August	55	55
September	22	22
October	23	23

Trip characteristics

Without the full MDS dataset from Bird, it is not possible to provide a comprehensive analysis of the trips taken by Bird riders. We do not have any reason to suspect that the seasonality or hot spots for travel would differ significantly between the two companies, but nonetheless it is not feasible to answer those questions with the information available. It is still possible, however, to point to some general trends using the information in the summary reports, as shown in Table 10. Notably, ridership saw a roughly 17 percent decrease from 2022 to 2023, with average trip distances remaining essentially the same. The active device count reported in 2023 significantly exceeds the maximum amount allowed in the South Lake Tahoe ordinance (500), although this could be due to some kind of fleet renovation or transition which is not explained in the data available. Also, the average number of trips per device is much lower in 2023 than 2022, with no clear reason other than that the number of active devices was listed as much higher in 2022. One possible explanation is that high snowpack in Spring 2023 may have led to a later start to the summer tourist season than normal.

Table 10: Aggregated Trip Data for Bird Scooters

Year	Unique Riders	Trips Taken	Active Devices	Trips/Device/Day	Average Trip Distance
2022	38,148	100,577	503	1.42	1.35
2023	32,415	83,814	797	0.35	1.34

Overview of Lime data

Lime provided detailed trip data for all trips taken in the Tahoe Region from the 2018 season through the 2023 season. This follows the last season where Lime Bikes were used through the establishment of the scooter ordinance and the addition of competition from Bird in 2022. We analyzed this data to study how ridership has evolved over time and to investigate the patterns of ridership during the permitted season. In Table 11, the trip data is summarized by program year and by mode. Since the bike program ended in 2018, all data from 2019 forward is only for scooter trips. In the last year with bikes, scooters saw much longer trip distances than bikes and roughly five times as many total rides. It is not clear whether this difference is due to rider preference for scooters, a much lower deployment of bikes in comparison with scooters, or that the bikes were non-electric compared to the electric scooters. Since 2021, the annual trip count has remained steady at around 170,000 scooter trips with some notable variation in total distance traveled and average trip distance.

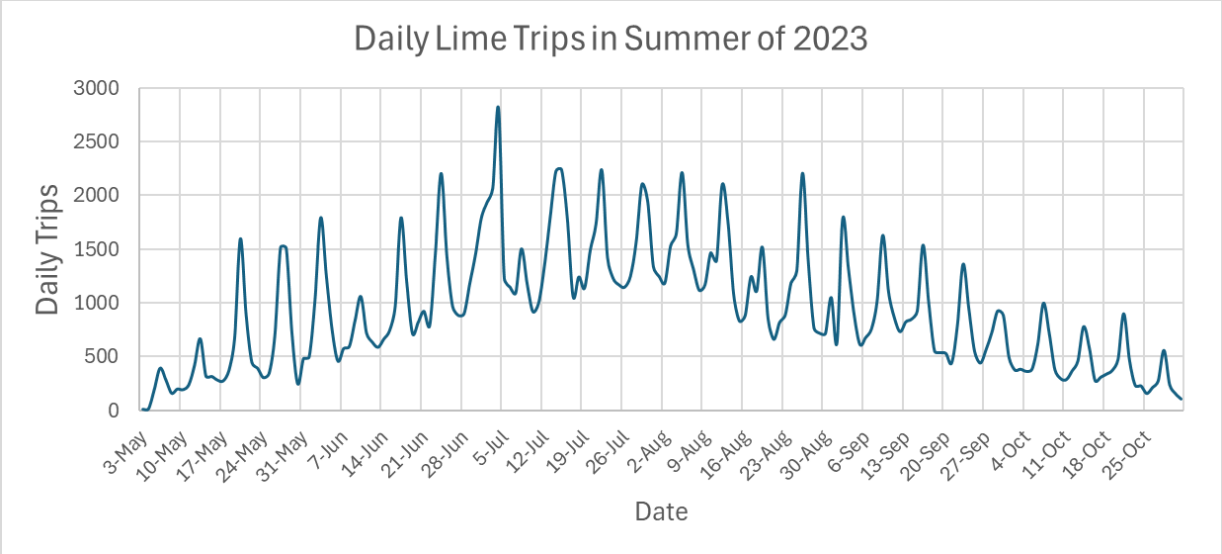
Table 11: Lime ridership trends across program years[27]

Year	Trips Taken	Distance Traveled	Average Distance
2018	33.7K bike, 152.7K scooter	32.2K mi bike, 218.1K scooter	0.95 mi bike, 1.43 mi scooter
2019	217,784	292,174 mi	1.34 mi
2020	211,332	184,702 mi	0.87 mi
2021	170,778	168,388 mi	0.99 mi
2022	171,322	213,248 mi	1.24 mi
2023	170,508	191,777 mi	1.12 mi

As Figure 28 illustrates, the ridership data from 2023 reveals the significant seasonality and weekly variation in scooter usage. Ridership gradually increases from May until reaching its highest point on the week of July 4th. During the season, there is a major contrast between weekday and weekend ridership, with weekend peaks being at least twice as high as the daily ridership of the previous weekdays. The riding season seems to wind down after Labor Day weekend, with ridership decreasing week after week until the end of the allowed operating period on October 31st.

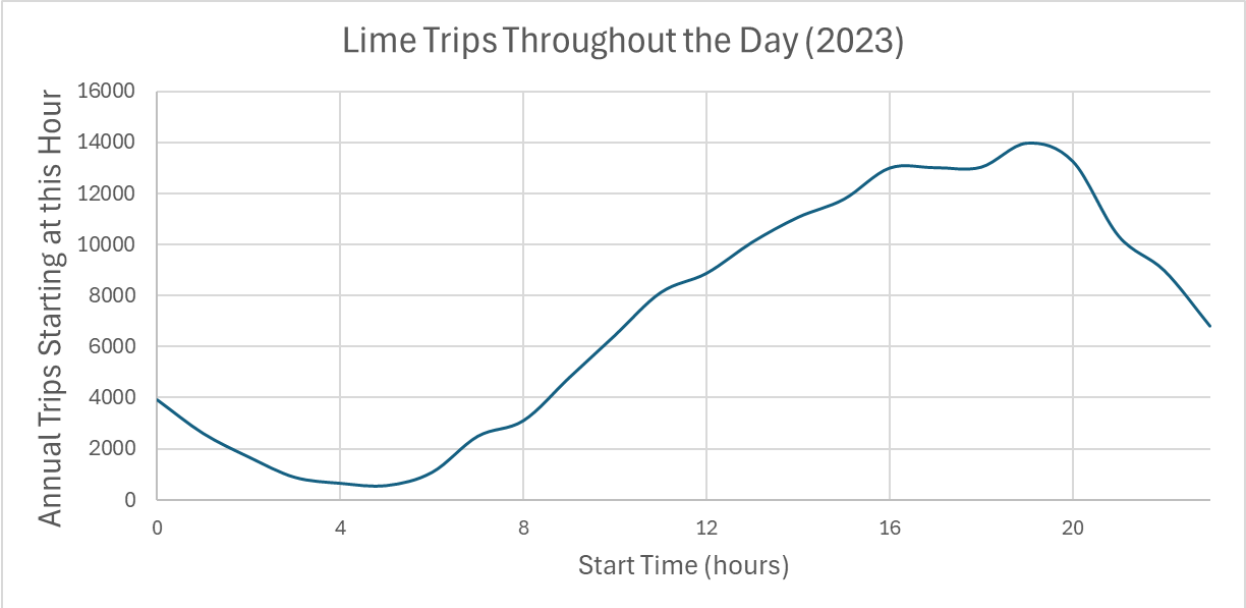
[27] Lime, All Lime Trips, 2023

Figure 28: Lime Trips Show Significant Seasonal and Weekly Variation



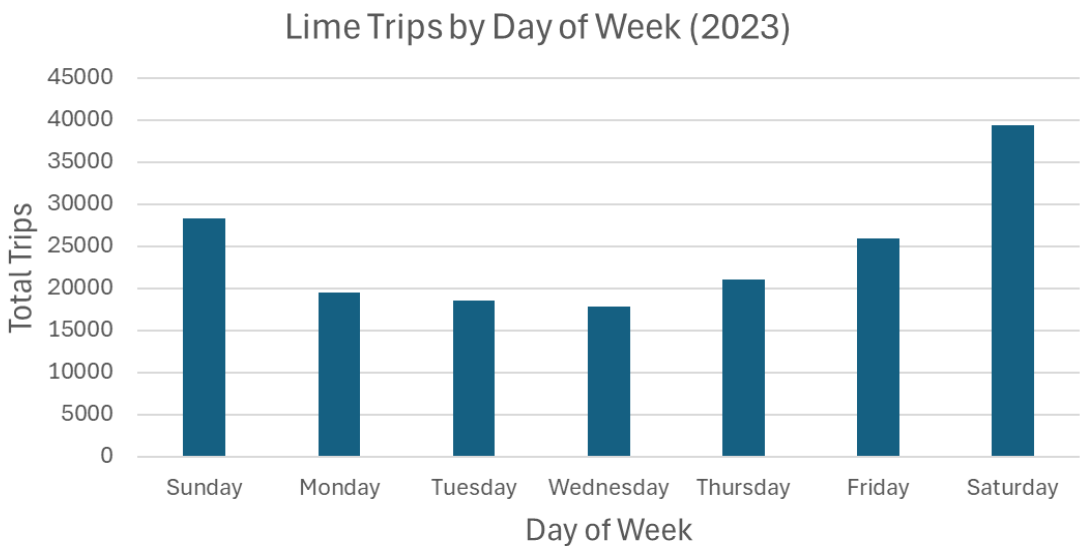
Next, we examined ridership throughout the day in Figure 29. The graph shows that people ride bikes at any time of day, even at night. But the most bike trips start in the afternoon and the evening, with 5 PM having twice as many trips as 10 AM.

Figure 29: Lime Trips show Peak Ridership During Evening Hours from 3-8 PM



We also looked at trips by the day of week. As shown in Figure 30, there is a clear difference in scooter use between the weekends and the weekdays. The data reveals that Saturday has the most riders per year, with Sunday having only 71 percent of Saturday's ridership and Friday having only 66 percent of Saturday's ridership. All weekdays except Thursday have less than half as many trips as Saturday. This exercise suggests there are possibilities for increasing ridership on regular workdays. It also indicates that most of these trips are probably related to tourism or recreation.

Figure 30: Lime Trips Have Highest Ridership on the Weekends



Hotspot Analysis

Using the data provided by Lime, a hotspot analysis was conducted to answer the following questions:

1. Which places see the most ridership in South Lake?
2. How do trip origins differ from trip destinations, if at all?
3. Is there seasonality (by month or day of week) to trip destinations?
4. How have scooter trip locations changed from 2018 to 2023, if at all?

Using data from 2023, we examined the first two of these questions. As shown in

Figure 31 and

Figure 32, origins and destinations have a significant amount of overlap. This makes sense because every destination becomes an origin if the next rider picks up the scooter where it was left. The only situation where a destination doesn't become an origin is when scooters are moved for charging or rebalancing to a more popular location. That said, destinations are notably more dispersed than origins, probably as a result of relocation to more popular starting points. Additionally, there is a clear set of hotspots in this dataset – with the most trips happening around the Stateline resort area on Highway 50 extending from Heavenly toward Lakeside Beach. There are several smaller hotspots along Highway 50 going East, such as near the Ski Run Marina, the Bijou Park neighborhood, the Bijou Shopping Center, and El Dorado Beach. A smaller number of trips are found further south near the Tahoe Center, South Y Center, and the Highland Woods neighborhood.

This dataset also indicates that riders seem to begin and end trips across the state line into Nevada, which is not officially allowed. Douglas County could consider permitting such cross-border activity. Stateline is also notably connected in its economy with South Lake, so it makes sense that it is difficult for riders to know that they are riding into an area which has not formally allowed scooters. Additionally, the scooter ordinance and contracts with operators make no mention of the state line, and this may be something which requires further clarity with the relevant jurisdictions in Nevada.

Figure 31: Trip Destinations for Rides in the 2023 season

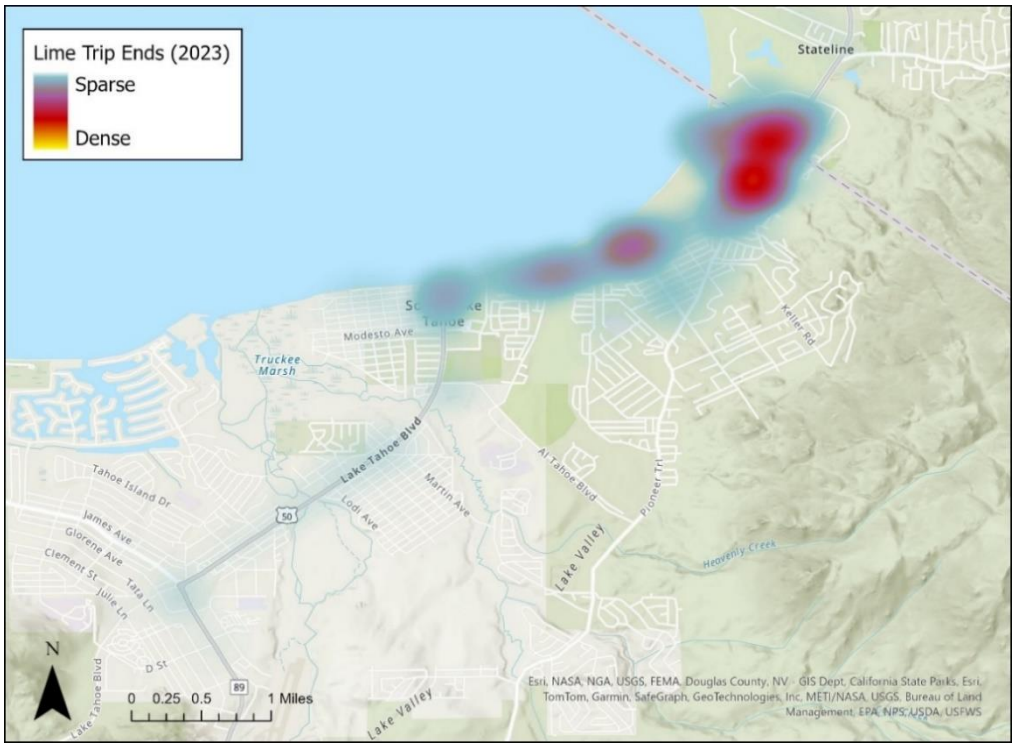
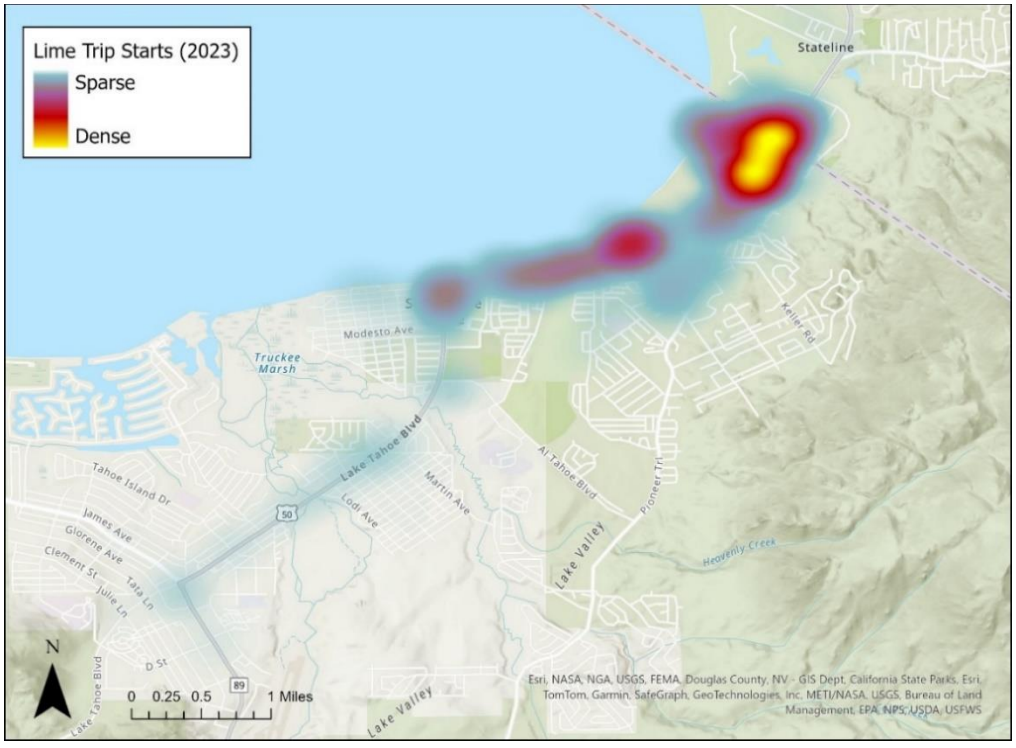


Figure 32: Trip Origin Locations for Rides in the 2023 season



Next, we looked at how ridership changes across the year and the week in different areas of scooter usage within the City. Figure 33 and Figure 34 show that while ridership volume has strong seasonality, trip origins stay fairly consistent. The main pattern we can observe is higher trip volumes to the lake areas like the beaches and marinas in July, and a higher proportion of

rides going to the southern areas along Highway 50 in October. We should mention that 2023 was an unusual year because of the very long ski season, but we have also looked at 2022 and we can confidently say that Tahoe has only minor seasonality in origins and destinations.

Figure 33: Lime Trip Starts Throughout the Year

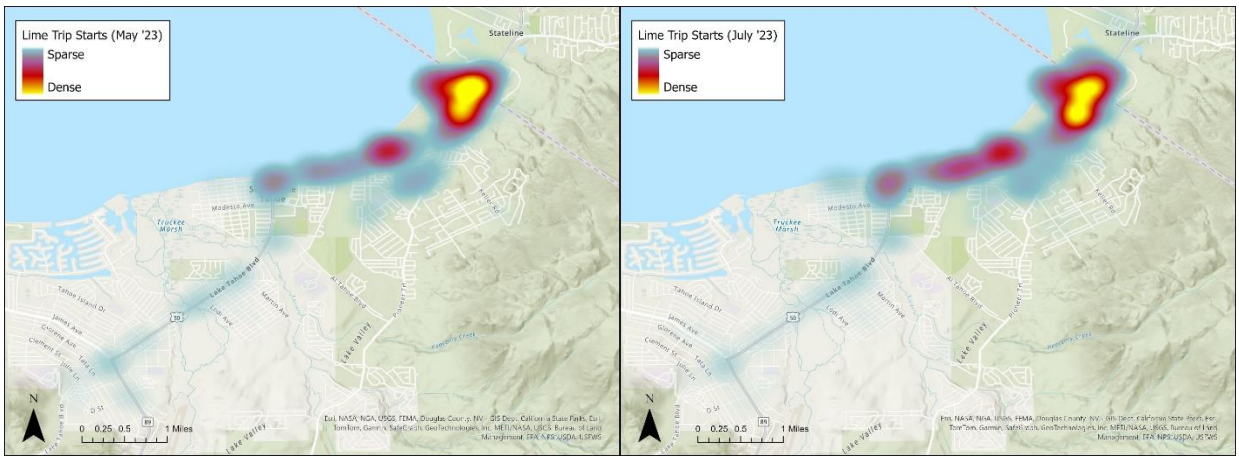
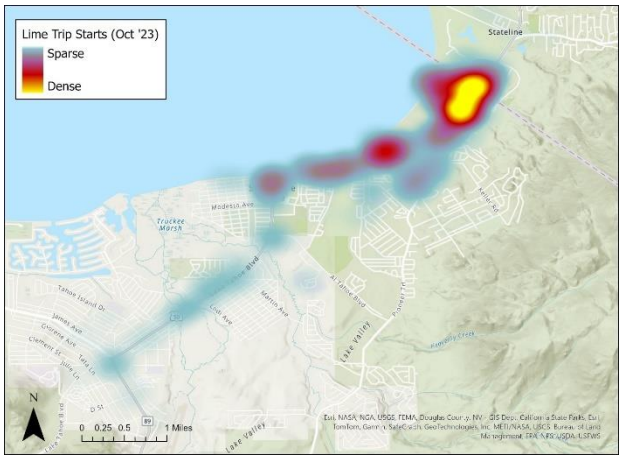
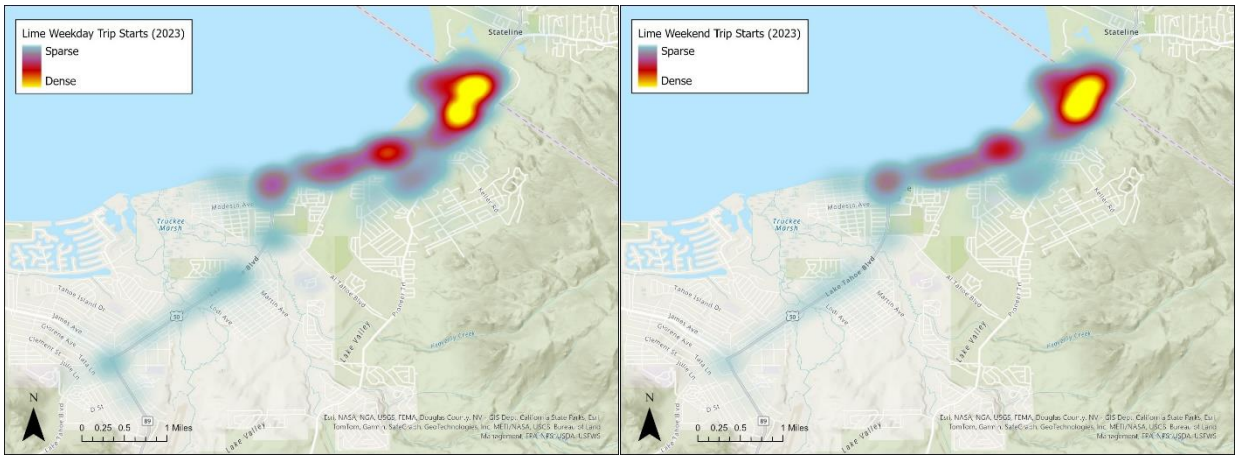


Figure 34: Lime Trip Starts in October Show Higher Ridership in the Southern Highway 50 Corridor



We then looked at how ridership changed throughout the week. Figure 35 illustrated that that ridership is much higher on Saturdays and Sundays than on other days. Therefore, we have plotted rides on weekends and weekdays separately. The ridership patterns are very similar again, but there seems to be more usage in the south corridor along Highway 50 on weekdays. We also noticed more ridership in the Bijou Park neighborhood on weekdays, which could suggest some use of scooters for commuting purposes.

Figure 35: Weekday Rides Appear More Dispersed and Concentrated Further South



Finally, our team examined the variations among ridership throughout the 6 years of data provided by Lime to the City. In this dataset, we find surprisingly little variation throughout the years. For the sake of completeness, these figures are included in the appendix to this document.

Recommendations

Policy considerations

Having introduced the current landscape of micromobility programs in the Tahoe Basin, we will examine a broad set of policy choices that TRPA and South Lake Tahoe should consider improving the existing programs and other areas of the Lake should consider in the development and expansion of programs to currently unserved areas in North Lake Tahoe and the Nevada side of South Lake Tahoe.

- First, we will consider policies around program equity, which are not well defined for the South Lake program, making it difficult for the City to know the impact the program has on low-income people or those without access to a car.
- Next, we will discuss the synergies in policies for constructing safe biking infrastructure with micromobility, making this infrastructure a win for a large coalition of users.
- Then, we will explain the research on how effective micro-mobility programs are at replacing vehicle trips and reducing traffic, demonstrating a clear benefit to the region. We will then examine policies around rider safety, which already exist in part but could be improved.
- Next, we examine policies around data-sharing from the micromobility providers, which is the main source of information for evaluating the impacts of these programs. Without access to the right data, it isn't possible to answer all the questions that the City and TRPA need answered about these programs. As such, we recommend a broader mandate in the data-sharing requirements.
- Additionally, we examine the expected effect of the California E-Bike incentive project on e-bike adoption in the region and note that this is something that TRPA should make all local bike shops aware of. We also discuss the current issues with micromobility

charging infrastructure, which is currently in its infancy but should be considered in the future as the standards for charging coalesce.

- Finally, we examine the use of program fees by the City and identify how that money is spent in other locales. Together, this set of recommendations can serve as a reference to TPRA and the City as they consider how these programs can be improved.

Program equity

Without an embedded equity-focus, even the most well-meaning program could end up increasing socioeconomic disparities. A Harvard study on upward mobility indicates that commuting time is the single most important factor in the ladder out of.[28] Yet, DACs have been historically marginalized in transportation policies, facing disproportionately higher commuting times, while often being disproportionately exposed to transportation-related pollution.[29] In South Lake Tahoe, DACs predominantly live on the outskirts, where access is limited by commute times and lack of urban mobility, among other barriers.[30] TRPA's Transportation Equity Study identifies these as "Community Priority Zones," where zero vehicle households may be over two miles away from grocery zones and medical facilities. To ensure that priority communities also receive the benefits of shared mobility, the City should incorporate robust equity requirements in its e-scooter program. For instance, it could consider the following:

- Equitable distribution of e-scooters: To ensure fair access, a specific percentage of e-scooters should be allocated to TRPA-defined Community Priority Zones. The City of Portland requires that 15 percent of e-scooter fleets be deployed in underserved areas, while the City of Los Angeles mandates 20 percent.[31] Los Angeles has also created permit fees and fleet number incentives to encourage operators to deploy in DACs.[32] Equitable distribution should also be practiced when redistributing shared mobility devices for fleet balancing. For example, Chicago requires 25 percent of all scooter fleets to be re-distributed nightly to two designated priority areas deemed to have the highest need.[33] Lastly, operators should be required to share equity plans outlining the steps they are taking to ensure equitable distribution. In cities where such plans are not required, major inconsistencies have been reported in operators' commitment to equitable distribution.[32]
- Affordable and discounted pricing plans: The City of Los Angeles and the City of Portland have mandated reduced fare plans for low-income riders, with discounts or free rides for "verified low-income users," i.e. those enrolled in state or federal assistance programs.[32] Though Bird and Lime both offer discounted prices in South Lake through the Community Pricing and Lime Access programs, respectively, the criteria for determining eligibility and the amount of discount may be tailored to South Lake's context through regulation, as is seen in other cities. However, any pricing caps

[28] https://www.nytimes.com/2015/05/07/upshot/transportation-emerges-as-crucial-to-escaping-poverty.html
[29]The Berkeley Electric Mobility Roadmap, available at: https://berkeleyca.gov/your-government/our-work/adopted-plans/berkeley-electric-mobility-roadmap.
[30] TRPA, Lake Tahoe Transportation Equity Study, available at: https://storymaps.arcgis.com/stories/c0b3a4f9e9ca403bbb7ad81560a6c661
[31] https://www.portland.gov/transportation/escooterpdx/2018-e-scooter-findings-report
[32] Regulating Micromobility: Examining Transportation Equity And Access, available at: https://readingroom.law.gsu.edu/cgi/viewcontent.cgi?article=1074&context=jculp
[33] https://learn.sharedusemobilitycenter.org/publication/efforts-to-improve-equity-of-bikeshare-programs/

established should not be so high as to prevent operators from reaching their profitability goals, prompting market exits.[34]

- Community Engagement: Effective community engagement is critical for successful implementation. The City of Los Angeles, for instance, mandates quarterly surveys and continuous community engagement by e-scooter operators to gather feedback and improve services. South Lake Tahoe should require e-bike operators to engage with local communities regularly, ensuring their needs and concerns are addressed. Lime has conducted significant community engagement in Los Angeles, reaching out to 99 neighborhoods councils and educational institutes, and regularly attending meetings with community stakeholders.[32] This shows that operators are willing and able to engage in such activities when required by the City government.
- Inclusive Marketing and Outreach: Shared mobility can often fill the gaps in public transit and private vehicle access that priority communities disproportionately face. Therefore, operators should be required to conduct marketing and outreach specifically targeted towards these communities. This could include campaigns in Spanish, since South Lake's priority groups largely constitute Latin Americans, and outreach at community centers and other public spaces based in Community Priority Zones.
- Adaptive Vehicles for Users with Disabilities: Ensuring that e-mobility options are accessible to all includes providing adaptive vehicles. Oakland, for example, mandates the inclusion of adaptive scooters for persons with disabilities in their fleet requirements.[35] In 2020, Lime rolled out 45 scooters with adjustable seats in Oakland, available for delivery to the resident's home. The City could consider a similar arrangement with operators Bird and Lime.

Overall, there are several opportunities the City could explore to enhance access to micromobility for underserved communities. Often, it is these very communities that lack affordable first and last mile options and rely the most on micromobility. Better connectivity for workers who regularly commute to the basin for work could also mean decreased road congestion and runoff into the lake, which the TRPA has identified as concerns for the City.[30]

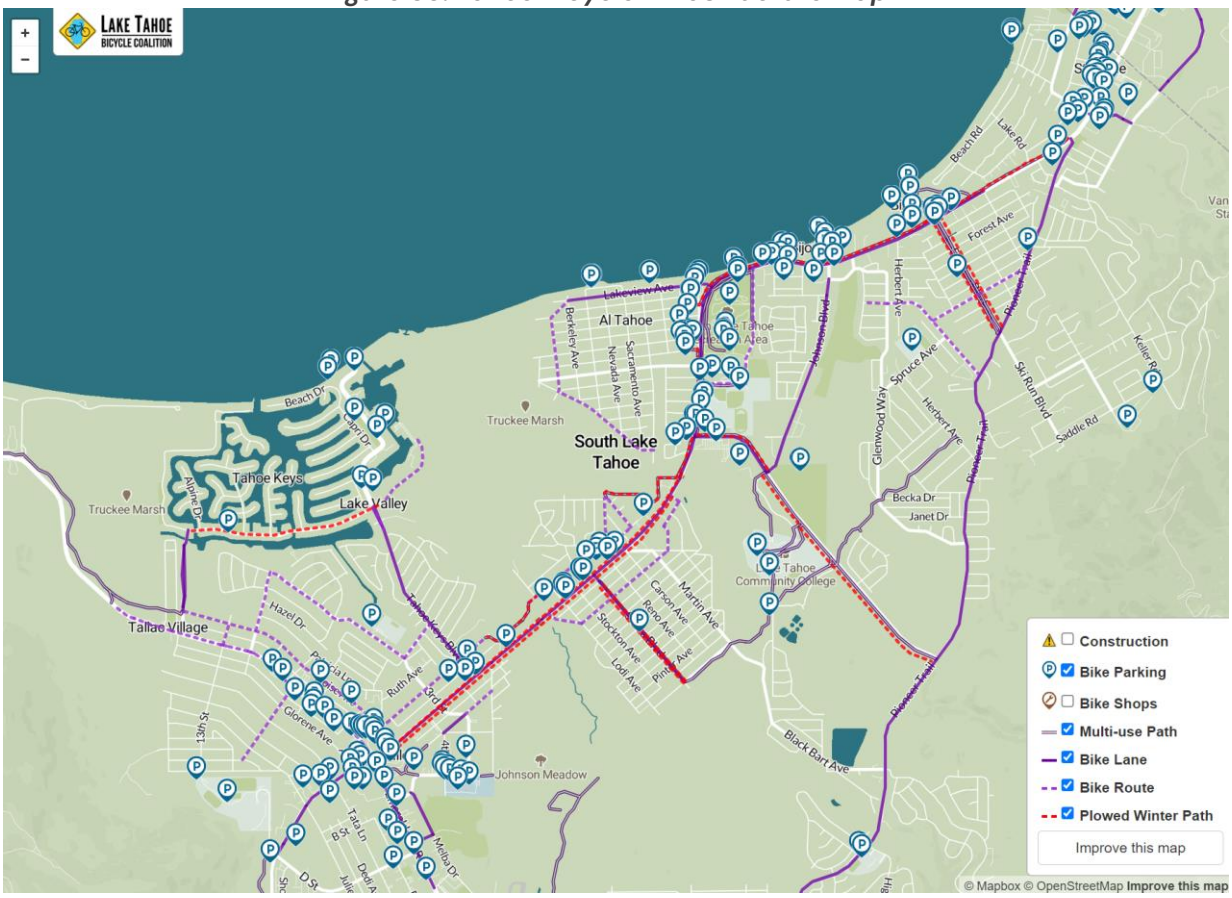
Infrastructure

To enhance the accessibility, safety, and user experience of e-scooter use, it is important to have supporting infrastructure, such as bike lanes and designated parking spots. The City's plan to create corrals for e-scooter parking is a major move in this direction, but there may still be service area coverage gaps due to the limited number of four corral locations. Since these locations were chosen based on user demand, we do not advise creating more corrals, at least for the time being. The only potential location for an extra corral would be north of Highway 50 in the Heavenly Village area, because it has the most riders and crossing the busy highway is needed to use the corral. Instead, the City could consider leveraging the extensive bike parking infrastructure, as seen in Figure 36 below, for e-scooter parking. For instance, riders starting or ending a trip between the corrals at Lake View Commons and the South Y

[34] https://www.marketplace.org/2018/12/05/scooters-could-improve-mobility-low-income-areas-they-have-image-problem/
[35] https://www.oaklandca.gov/news/city-of-oakland-announces-2021-e-scooter-service-providers-safety-improvements-to-overall-program

Transit Center could utilize bike parking infrastructure along South Lake Boulevard. In areas that have limited land availability for building scooter parking infrastructure or low-population density resulting in relatively lower ridership rates, this approach could be particularly helpful. Additionally, having riders park scooters in parking structures instead of on sidewalks would minimize the possibility of obstructions that pose a danger to pedestrians and vehicular traffic.

Figure 36: Tahoe Bicycle Infrastructure Map[36]



To effectively utilize bike parking infrastructure, the City could draw inspiration from the City of Oakland, which requires e-scooters to include integrated locking mechanisms, allowing them to be secured to bike racks. Bike rack accessibility for cyclists could be maintained by requiring operators to limit locking to one scooter per rack. It should be noted that such a requirement would be difficult to enforce so if a locking mandate was added, we would highly recommend working with the Lake Tahoe Bicycle Coalition to install additional parking infrastructure. Additionally, fees collected from the e-scooter program could fund the installation of new bike racks annually, prioritized based on demand data. The City of Oakland also provides a form on its website where community members can request a rack, providing further insights into parking demand.[35]

Though South Lake's bike lane network is widespread, the City might want to consider further investment in this area to maximize the utility, safety, and adoption of both e-scooters and

[36] https://map.tahoebike.org/

bikes. Research indicates that users prefer riding on low-speed streets and in bike lanes, with many of the highest-utilized routes being part of existing bikeway networks. Dedicated bike lanes reduce the incidence of illegal sidewalk riding and improve overall safety for both riders and pedestrians.[31] This issue can also be partially mitigated through education, such as including a notification in the app informing users that riding on the sidewalk is illegal. However, if a rider does not feel safe, app notifications alone may not suffice, and they may still resort to using the sidewalk if it appears to be the only safe option. Additionally, e-scooter adoption is closely tied to how well-connected the bike lane network is with high population-density residential areas.[37] The last section of this report recommends specific locations where bike lane investments could be considered.

VMT displacement

E-scooters have varied effects on VMT displacement. They are designed to mainly replace car trips, but they can also frequently displace active modes of transportation, such as walking, biking, and public transit, which can result in higher emissions instead of lowering them. A 2023 study that examined modal substitution by shared e-scooters across major U.S. cities showed walking as the most substituted mode (30-60 percent), closely followed by car trips.[37] Public transit and biking were substituted less frequently (around 10 percent or less), though major variations were observed in cities with high reliance on urban mobility.[37] In South Lake Tahoe, where transportation patterns depend on seasonal and tourist factors, it is essential to know how these substitution patterns may appear to make sure that scooter sharing's benefits on VMT reduction are optimal. The City's requirement for operators to survey users every six months to gather information for future planning, including asking about what mode of transportation was replaced for the use of a Shared Mobility Device, is a good starting point. To further this effort, we recommend the following changes for higher quality responses.

- Reducing the survey timeframe: Retroactive surveys that require users to recall behavior far in the past can produce less reliable results.[37] Instead, users may be prompted to fill out a short survey following each ride, a common practice in the service industry. Operators may still conduct more comprehensive surveys bi-annually to add further granularity.
- Trip-specific questions: General survey questions such as those that ask users what mode they are substituting with an e-scooter could be impacted by certain response biases, including social desirability bias. Instead, users may be asked for details of a specific trip, ideally the latest one.
- Substitute vs. supplement assessment: In addition to substituting existing trips, e-scooter availability may also result in new trips that would not have otherwise been taken. This information can help evaluate the substitution effect of e-scooters more accurately, as well as coverage effects.

A nifty example of a survey prompt that incorporates the above can be found in the Portland Bureau of Transportation's survey for its 2018 Pilot Program.[31] The survey asks, "If an e-scooter had not been available for your last trip, how would you have made that trip?" Response

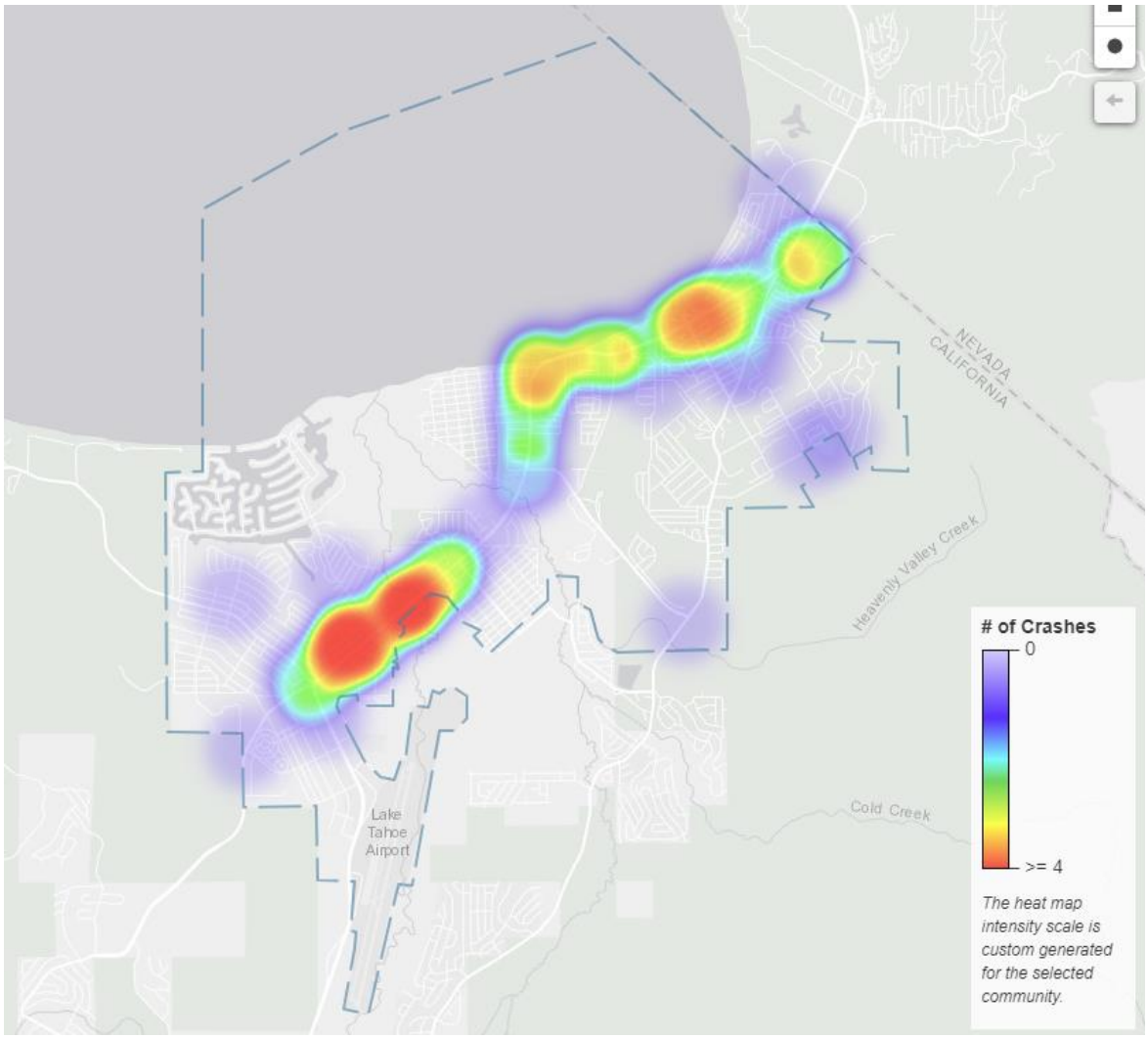
[37] What travel modes do shared e-scooters displace? A review of recent research findings, available at: https://www.tandfonline.com/doi/full/10.1080/01441647.2021.2015639

choices included alternative modes of transportation and an option indicating they would not have made the trip at all.

Safety

Safety is an important consideration when allowing a micro-mobility program because riders are vulnerable road users (VRU) who are close to cars with no protection from them. Using the Transportation Injury Mapping System, we have visualized the locations of active transportation crashes in South Lake and included them in Figure 37 below.

Figure 37: Injuries to Bicyclists and Pedestrians in South Lake Tahoe from 2017-2023[38]



[38] https://tims.berkeley.edu/

The micro-mobility ordinance has several tenets addressing rider safety and non-rider safety combined with enforcement to ensure compliance[20] These measures include:

- Limiting maximum scooter speed to 15 miles per hour
- Prohibiting riding in pedestrian-only areas such as Heavenly Village
- Requiring riders be 18 years of age or older
- Banning riders with 2 or more operating citations
- Preventing renting of more than one device at a time
- Ensuring that parked scooters do not block access to sidewalks, ramps, driveways, vehicular traffic, etc.
- Ensuring that scooters are not parked within a bike lane or trail.
- Issuing administrative citations to those who violate the statutes.

These steps meet most of the main criteria for making sure that pedestrians and disabled users have space and are safe from scooters. They also discourage use by those who are not eligible, such as children, or by those who keep breaking the rules.

The main policy related to rider safety is the speed limit of 15 miles per hour. This is a common and sensible rule because inexperienced riders are more likely to get hurt in high-speed collisions, especially without helmets. California does not require helmets for scooter riders older than 18, intending to encourage impromptu ridership, which may not happen if helmets were obligatory. The rule restricting usage in pedestrian-only areas also serves to help keep riders separate from pedestrians where possible. That said, riders are allowed on multi-use paths so there are nonetheless going to be conflicts between riders and pedestrians.

Two other general measures can also drastically impact rider safety. Firstly, ensuring proper lighting for riders at night is essential for preventing crashes and avoiding potholes and other hazards. Where practical, lighting is a cost-effective infrastructure solution for bike lanes and mixed-used paths, making it possible to ride safely at all hours of the day. Appropriate safety lighting should be consistent with regional dark sky lighting standards. Secondly, offering as much connectivity as possible between safe routes prevents conflicts between riders and cars, reducing the risk of crashes. South Lake Tahoe has a fairly robust network of Class I and II bike infrastructure, however, improving connections in that network can have synergistic effects for both ridership and safety for micromobility users as well as cyclists and pedestrians.

Data sharing

Data sharing is essential for the accurate assessment and achievement of shared mobility projects, as we are still discovering how the technology affects VMT, safety, and accessibility. However, in reviewing the micromobility ordinance and operator permits, we found an unusually short list of data-sharing requirements, making it difficult to adequately assess program effectiveness with available data. Specifically, the City[39] requires Bird and Lime to share the following data:

- Operator data, including the type and number of devices owned and a deployment schedule.

[39] City of South Lake Tahoe Shared Mobility Devices Guidelines, 2024

- Anonymized trip data, including trip times, distance, origin, and destination.

Looking at the data shared by operators over their operations, an important gap we identified pertains to equity questions. Lime's data primarily covers trip origin and destination information, which not only limits our understanding of usage patterns and rider behavior but also offers no insights into Lime's equity practices. On the other hand, Bird's data touches on equity topics at a surface level, covering a sample size too small to be considered representative or reliable. As these data limitations could severely hamper the City's ability to incentivize or direct change and ensure an equitable distribution of shared mobility benefits, we provide examples of equity data requirements that other cities are pursuing for consideration:

- Demographic reporting: Washington, D.C. mandates that e-scooter companies report on the demographics of their users to ensure the program serves a diverse population.[40]
- Service availability: Seattle requires that a certain percentage of e-scooters be deployed in underserved areas (at least 10 percent) and operators must report on the distribution of their fleet.[41]
- Barriers to access: Chicago's pilot program included extensive surveys to understand reasons behind non-use, particularly among low-income residents and communities of color.[42]
- Community engagement and feedback: Portland engaged community organizations and held public meetings to gather feedback from residents, particularly from marginalized communities, to inform program adjustments.[31]

E-bike incentives

E-bike adoption is increasingly being driven by local and state incentive programs that make them affordable to the public. The California Air Resources Board's (CARB) E-Bike Incentives Project is the most significant effort thus far to promote statewide adoption, offering California residents up to $2,000 point-of-sale incentives to purchase a new e-bike.[43] This amount effectively covers the full cost for many models, demonstrating the state's commitment to e-biking and providing reasonable grounds for the City to anticipate a surge in e-bike ownership and usage in South Lake. The City could enhance the local effects of CARB's project on the environment, which are significant compared to other transportation options, by spreading knowledge, raising awareness and providing additional incentives. The City could launch campaigns to raise awareness about CARB's project, its benefits, and how to apply for it. Education efforts could include information on safe riding practices and bike maintenance. Additionally, by providing additional incentives that could be stacked on to the ones offered by CARB or other organizations, the City could maximize adoption rates, ensuring that any resident who wants to purchase an e-bike is able to do so. Such a program could be funded through the fees paid by Bird and Lime.

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[40] https://sharedmobility.ddot.dc.gov/pages/equity
[41] https://www.seattle.gov/documents/Departments/SDOT/NewMobilityProgram/ScooterShare_Pilot_Report_Final.pdf
[42] https://www.chicago.gov/content/dam/city/depts/cdot/Misc/EScooters/2021/2020%20Chicago%20E-scooter%20Evaluation%20-%20Final.pdf
[43] https://ebikeincentives.org/

Micro-mobility charging

Charging infrastructure availability for e-scooters could be critical to reducing emissions given that most of the lifecycle emissions of e-scooters come from charging and maintenance. Dockless e-scooters are usually transported between pick up/drop off locations for recharging or fleet balancing purposes several times a week in non-electric vehicles. Alternatively, polluting vehicles may be used to travel to where an e-scooter is parked to swap out an expired battery. E-scooters often have batteries that last only a short while, requiring frequent swapping or scrapping. The worst batteries may last only six months and have the worst environmental impact out of all the modes of transportation. Although research and programs in this area are still emerging, we want to flag a couple of measures the City could consider further investigating:

- Mandating long-lifespan battery types: Research shows that e-scooters that last 24 months and have swappable batteries replaced using zero emission vehicles have a lower environmental impact than private cars, electric mopeds, and public transport buses.[44]
- Prioritizing clean energy use: Where feasible, solar-powered docking stations could be installed in partnership with private companies to ensure clean energy use. Additionally, the use of zero-emission vehicles for distribution and maintenance operations could be encouraged through cash and other incentives.
- Establishing unified charging standards: Having a unified charging standard for e-scooters would help to streamline the charging process, allowing for the development of public charging infrastructure in a cost-effective manner. We recommend that the City refrain from using dedicated micro-mobility charging until there is a standard for it. Such a standard does not exist at the moment, and this poses a challenge.
- Strategic placement of charging stations: Short travel distances in South Lake allow for infrequent charging of e-scooters, requiring only a few strategically placed chargers. Optimal locations could be determined using ridership rates near transit hubs and residential areas as well as proximity to corrals.

Use of program fees from e-mobility programs

According to the micromobility ordinance, South Lake requires operators to pay a $75 fee for every e-scooter in their fleet. Currently, the entire sum is transferred to South Lake PD, which is responsible for enforcing the regulations set out in the micromobility ordinance. While enforcement is an important component of these programs, these fees could also be used in the other ways as well:

- Investment in low-cost infrastructure: A portion of the fees could be used to make low-cost infrastructure improvements, such as painting bike lanes and installing plastic bollards. These enhancements can create safer environments for riders and pedestrians, reducing the risk of accidents and improving overall user experience. Washington, D.C. saw significant advancement in safety from investing in bike lane infrastructure, leading to increased usage of bikes and scooters.[45]

[44] https://www.popsci.com/environment/e-scooter-sustainability-micromobility/
[45] https://visionzero.dc.gov/pages/2022-update

- Small grants and subsidies: These funds could be used to incentivize operators to pursue equity pricing programs, cap user fees, and adhere to geographic operating requirements. The City of Denver waives program fees for operators who meet robust equity benchmarks and build parking infrastructure, whereas Washington, D.C., offers scaled refunds based on the percentage of miles low-income riders travel compared to the overall rider pool.[46]
- Education and awareness: The fees could be used for education and awareness about rider safety, given the surge in scooter-related injuries and associated health costs. A study conducted by the University of California, Los Angeles, found that micromobility injuries have been increasing by 23 percent, on average, every year, with scooter riders more likely to end up with serious injuries, requiring surgery or becoming paralyzed, compared to bike riders.[47] The study concluded that increased rider education could mitigate serious injuries associated with e-scooter use. Through such education, the City could promote adherence to traffic rules and general safety practices such as helmet use. The City could also make residents aware of South Lake PD and Lime's free helmet giveaways.

Bikeshare

Given the existence of a dockless bikeshare program in South Lake Tahoe for two years, here in this section we plan to explore the benefits and drawbacks of establishing a bikeshare program in the Basin. As noted earlier in this report, South Lake Tahoe was one of the pilot cities for Lime (known as LimeBike at the time) and hosted a small fleet of conventional dockless bikes in 2017. In 2018, Lime introduced their e-scooters alongside a small fleet of bikes and as part of the 2019 contract, Lime dropped the bikes altogether. For reference, the map of scooter and bike trips from 2018 is included here in

[46] https://usa.streetsblog.org/2023/09/20/study-how-low-income-people-really-use-micromobility
[47] National Trends and Clinical Outcomes after Scooter Injury in the US: 2016 to 2020, available at: https://pubmed.ncbi.nlm.nih.gov/38193571/

Figure 38 and Figure 39. As presented in their City Council meeting on March 19th, 2019, Lime made the operational decision to focus on scooters for that season, and this was then agreed upon in their contract signed a few weeks later. In writing a micromobility ordinance later in 2019, the City clearly stated that operators may not rent bikes. News reporting from this time seems to indicate this decision was made in part due to a concern over competition between bike shops and bikeshare, although the exact rationale is not.[48] With this ordinance in place, any attempt to bring bike-share back would first require an amendment to this ordinance, so it should be noted that such a change would require political consensus and significant local backing.

[48] https://southtahoenow.com/story/03/20/2019/lime-scooters-not-lime-bikes-return-south-lake-tahoe-summer

Figure 38: Bikeshare Trip Origins Appear Slightly More Dispersed Than Scootershare

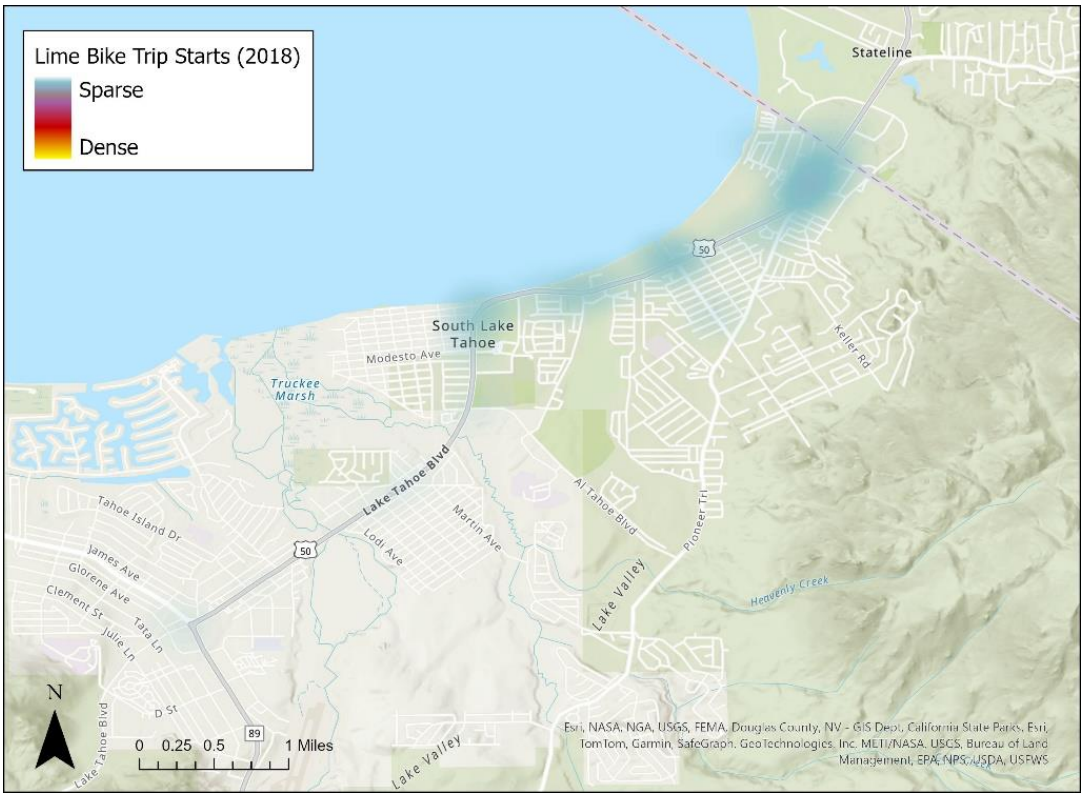
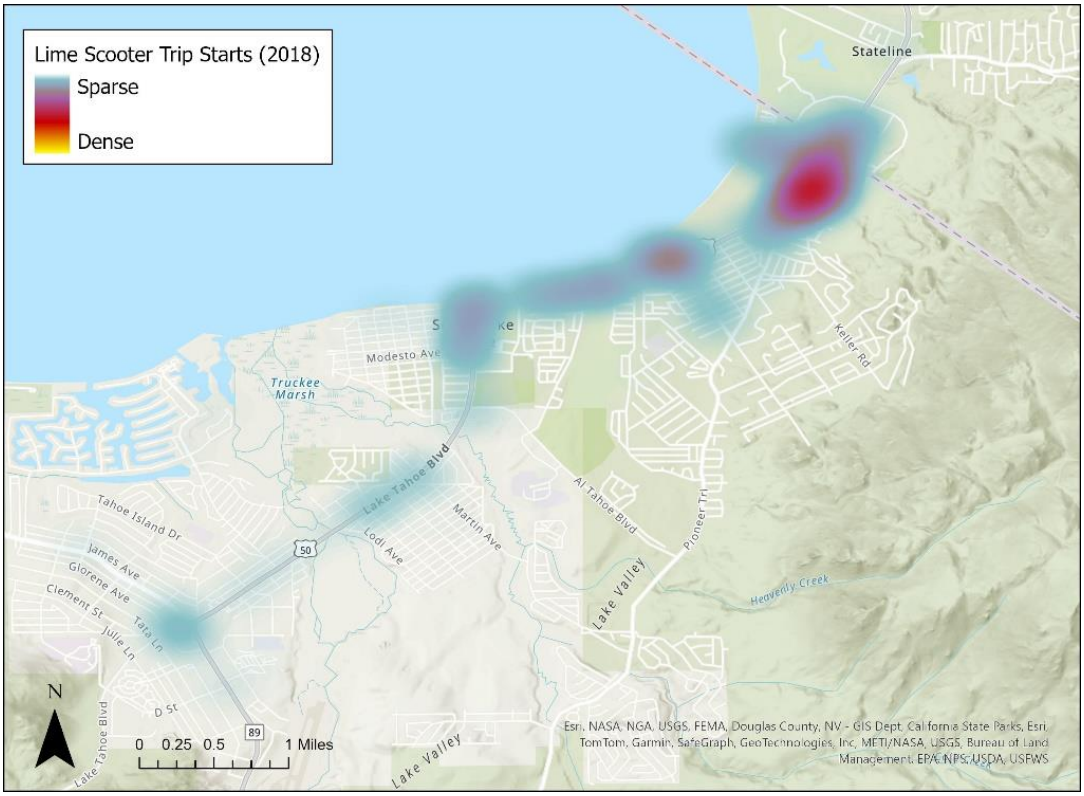


Figure 39: Scooter-share Trip Origins in the Same Year Show Concentration near Stateline



In considering bikeshare as a possible solution, we must clarify that there are two differing forms: dockless and docked bikeshare. Docked bikeshare systems rent bikes from a "station", and all trips must start and end at a station. These systems make it possible to rent a bike without using an app and in the case of e-bikes can charge the vehicles while docked. They also restrict the shared bikes to a much smaller area with less risk of vehicles blocking sidewalks or rights-of-way. Dockless systems allow trips that start and end anywhere within a designated area, similar to the existing scooter-share system used in South Lake. Dockless systems are much cheaper to deploy because there is no need to build or maintain docking infrastructure, and they have the added benefit of providing more accessibility to riders since trips can start and end exactly where a rider wants to go rather than where stations happen to be located. As such, dockless systems tend to work better in more spread-out locales like the Tahoe Basin. Additionally, since both Bird and Lime offer dockless bikeshare as a service, it would be the easiest transition for the existing operators. Finally, given that benefits differ between shared e-bikes and conventional bikes, we will assume that these providers would choose e-bikes because they offer higher rates of adoption and longer travel distances.

Recognizing that dockless bikeshare is the best option for the Tahoe Basin, there are many advantages of bikeshare compared to scooter-share. The biggest benefit for the region would be that bikes tend to displace car trips at a higher rate than scooters.[49] There are a couple of reasons for this – for one, bikeshare bikes usually come with a basket and have a higher utility, so they can more easily replace trips to the store or where one would otherwise need to carry things. In addition, scooters are often used for recreational trips, or those trips for which riding is the main purpose, rather than going somewhere. These kinds of trips do not typically replace a trip otherwise taken by car. Finally, scooters are often chosen as a mode of transport on the fly, so they are more often used to replace short-distance walking trips. Another benefit is that on average, dockless bike systems have higher trip distances (1.9 mi) than dockless scooter systems (1.3 mi).[50] This fact was not borne out in the data from the 2018 Lime program – which showed higher trip distances among scooters (0.95 vs. 1.4 mi), but the City might expect this result to coincide with other programs in the state if those bikes were electrified. The final benefit would be that e-bikes tend to have a higher utilization per vehicle – so a smaller number of bikes would be needed to accommodate the trip demand in the region. They also are better for rider health since pedaling is required.

Knowing these benefits, dockless bikeshare also has several disadvantages over scooters. Bikes are larger than scooters and take up more space when parked, leading to an increased need for appropriate parking areas. Bikes also cost more to produce per vehicle than scooters, and as such must be able to make up for this with proportionally higher revenue. They are also harder to relocate en masse since fewer bikes fit into a truck. Due to this, even if the City amended its micromobility ordinance to allow for bikeshare, it is not certain that these providers would offer it as an alternative to their scooters. Similarly, one of the main concerns addressed by the ordinance was that too many scooters were located within South Lake Tahoe, so adding a new form of micromobility would worsen that problem unless the cap was kept at 1000 vehicles. That said, TRPA could consider bikeshare programs in other areas in North Lake Tahoe such as Incline Village, Tahoe City, and Kings Beach. Truckee already has a

[49] Assessing environmental benefits from shared micromobility systems using machine learning algorithms and Monte Carlo simulation, available at: https://www.sciencedirect.com/science/article/pii/S2210670722005157
[50] 2022 Shared Micromobility State of the Industry Report, available at: https://nabsa.net/2023/08/10/2022industryreport/

successful docked bikeshare program with BCycle and could serve as a useful local example in understanding how such a service might operate.

In summary, despite the notable concerns with bikeshare, we would recommend that the TRPA consider bringing bikeshare into the region. One small step would be to have South Lake amend the micromobility ordinance to allow micromobility operators to offer bikeshare. This action alone would at least open the door to bikeshare within the region, and by keeping the cap at 1000 vehicles, Tahoe could at least maintain the level of service within the region without overwhelming residents. This would also make it possible for a micromobility operator who only offers bikeshare to enter the Tahoe Basin market and compete with the existing companies. TRPA could also examine other locations in the Basin which might work as part of a smaller bikeshare program like what is found in Truckee.

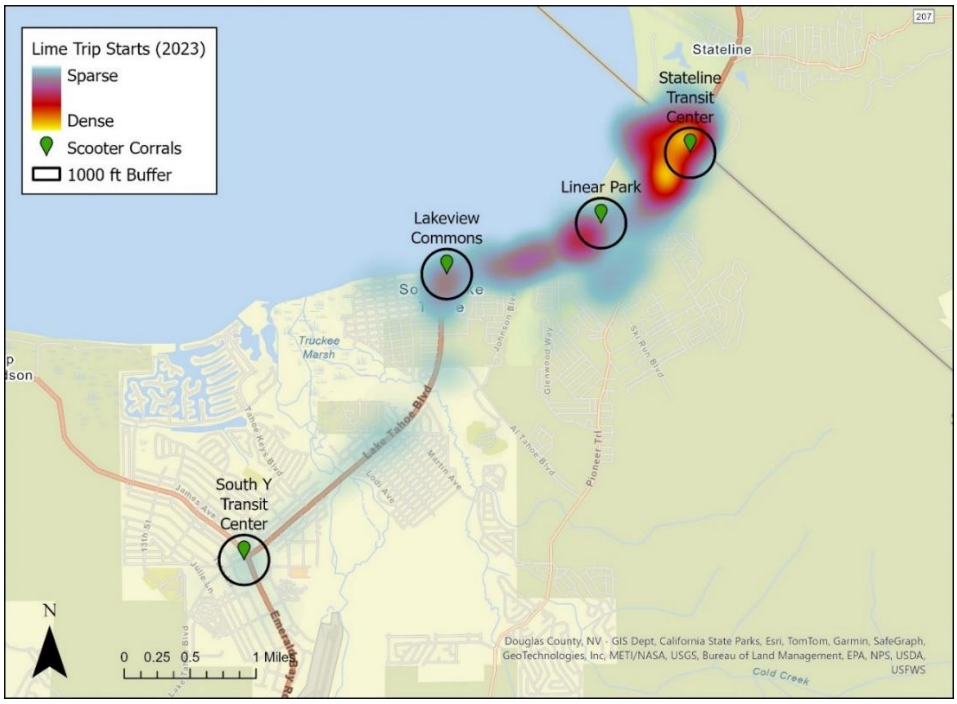
Focus Areas for Micro-mobility

After conducting thorough research on scootershare in the area we have determined one primary route as the target area for ridership in the City. This corridor, as shown in

Figure 40, extends from the Nevada state line westward down Highway 50 to El Dorado Beach. As shown, this zone fits well into the new corral locations established by the City, with the Stateline Transit Center covering the eastern part of this zone, Linear Park covering the middle of this zone, and Lakeview Commons covering the western part of this zone. Our data suggests that the Y Transit Center next to the Raleys is far less popular as a destination and may not require a corral to contain the scooters due to popularity – however, it would still free up space in the parking lot for cars and make scooters easier to find for users of the Amtrak bus stop there. Another observation is that while trips at Lakeview Commons match well with the pattern, for the other two corrals – most trips tend to originate more southwest. In the case of the Linear Park site, it appears that many trips start in the shopping areas or at the Marina (around 1000 ft away), and in the case of the Transit Center, many trips start from the edge of Heavenly Village or the Village Center shopping mall (slightly over 1000 ft away). With this new system, the City should carefully evaluate how these corrals impact ridership and patterns around trip starts and ends to ensure that the amended ordinance is not leading to major reductions in overall ridership.

Knowing that this corridor is a clear hotspot in scooter ridership, the City should consider a few interventions to synergize with this ridership. First, the City could build organized scooter parking areas using low-cost infrastructure such as paint and temporary bollards to make it clear to riders how they should use the corrals. They could also add signage to nearby areas like the Marina, Hilton Vacation Club and Ski Run Center to help direct riders to the corral nearby to help with parking compliance and to make it easier for possible riders to find the scooters. This signage need not be permanent and could be accomplished with a variety of low-cost options like vinyl or even yard signs. Property owners must be consulted for such interventions to which they may be agreeable knowing that it would help reduce incorrect parking of scooters within their property. Similarly, signage at Heavenly Village and the nearby resort hotels would help potential users find the new corral at the Stateline Transit Center.

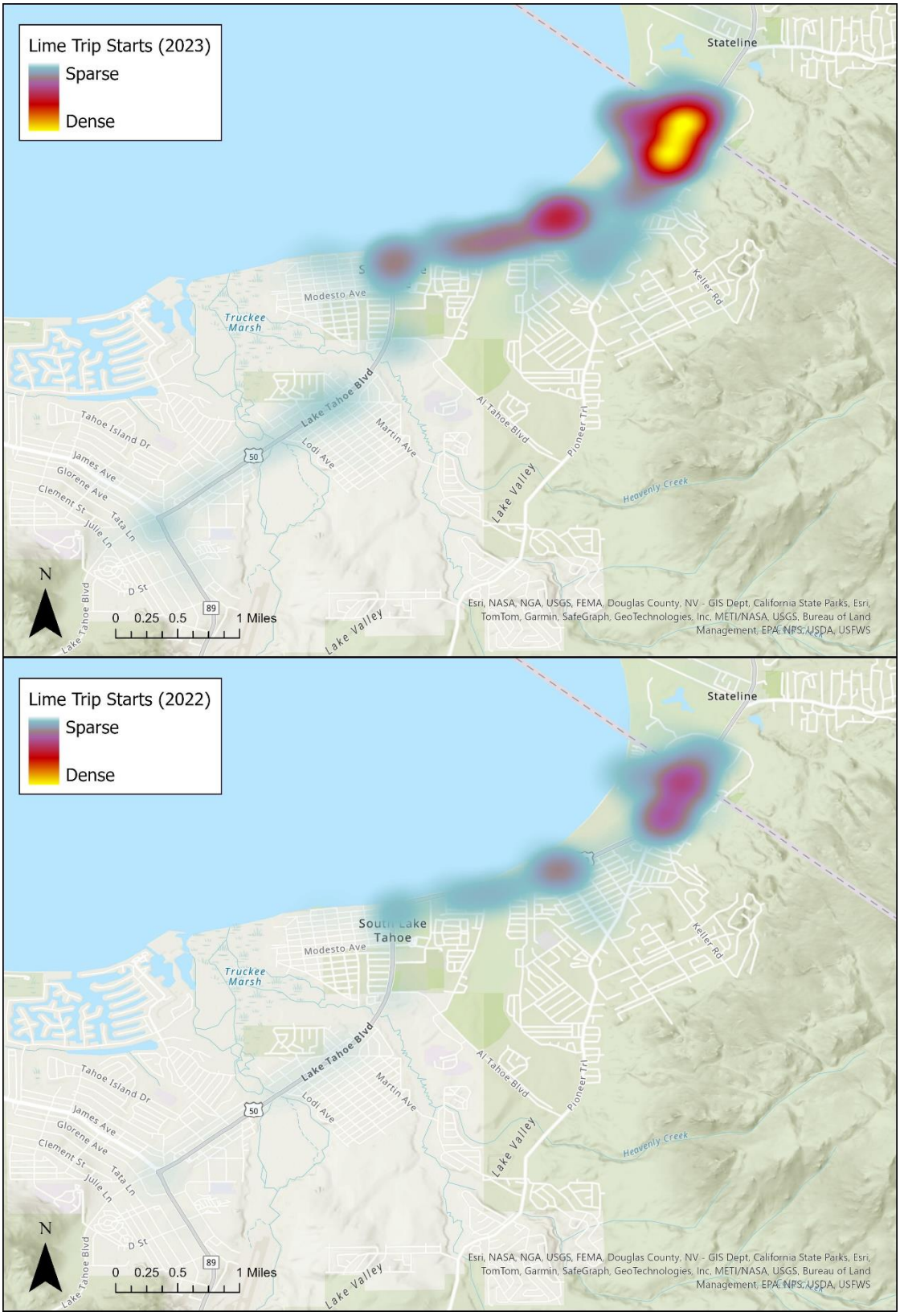
Figure 40: Scooter Corral Locations Overlaid with 2023 Lime Trip Origins

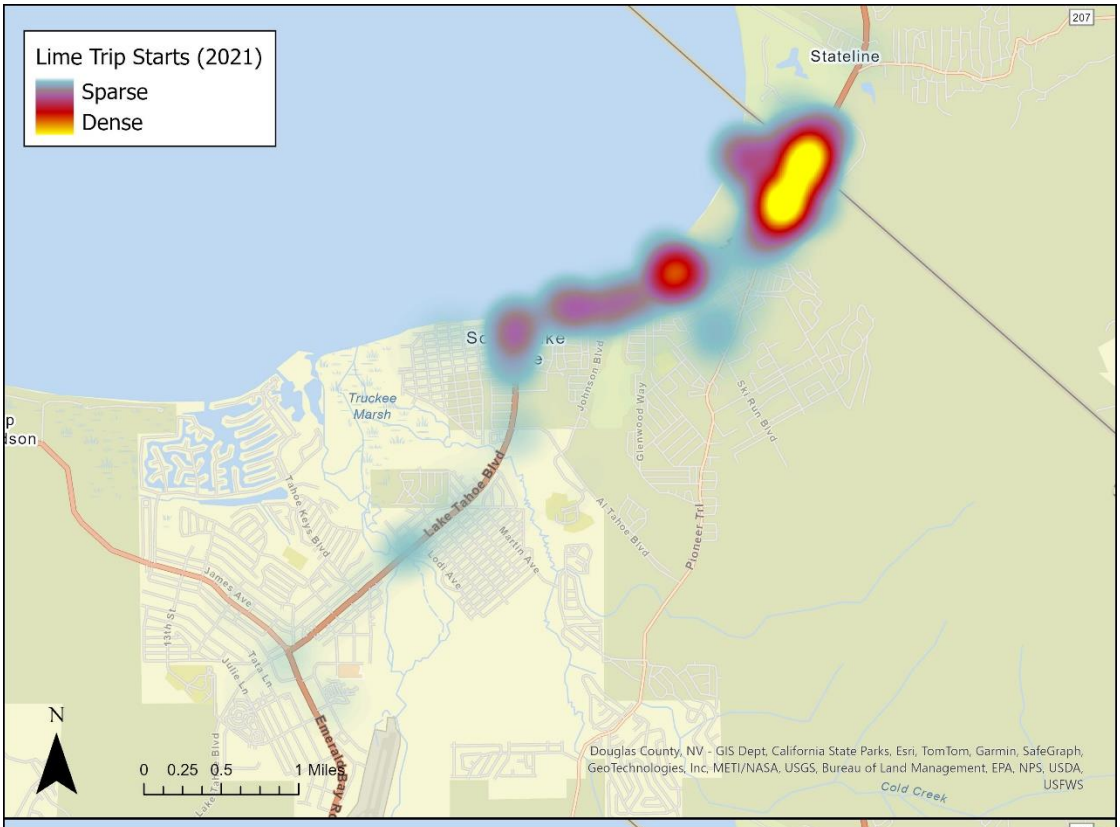


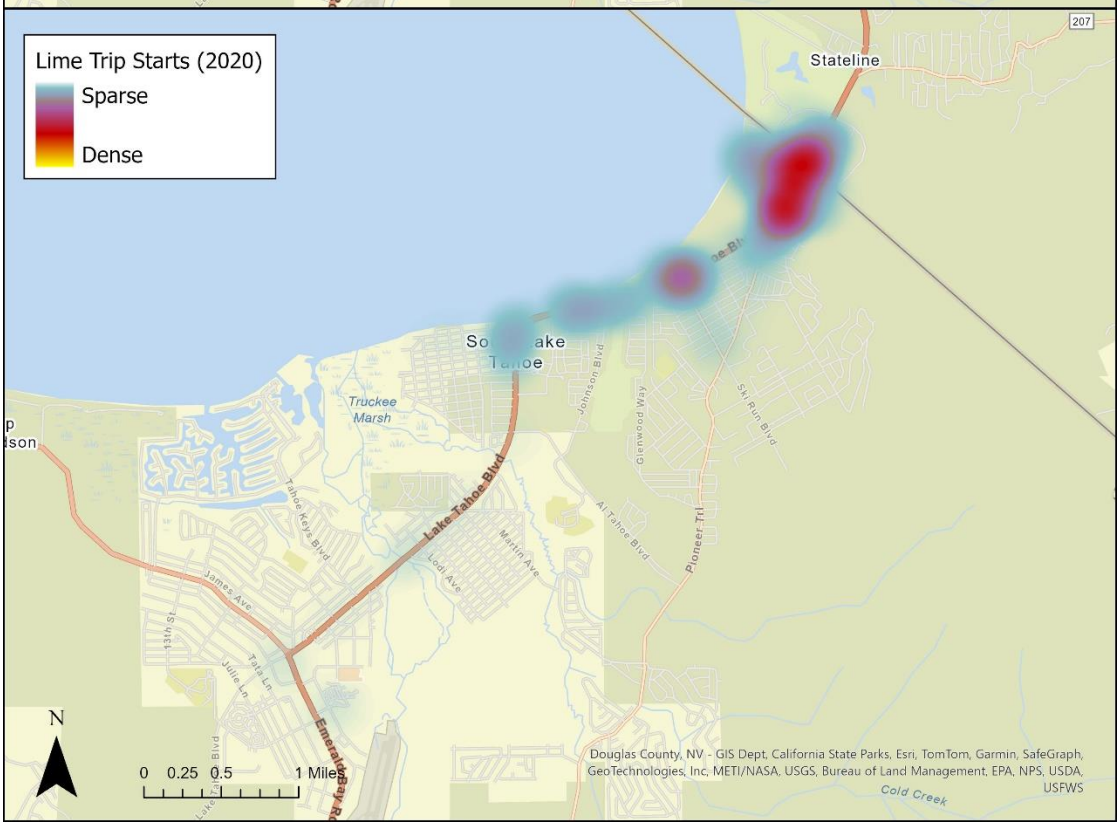
We would suggest a more significant improvement by adding a bike lane or multi-use path along Highway 50 from Pioneer Trail to the state line. This area has the highest demand for cycling and also the highest risk, with no protection for riders who follow the California vehicle code and ride on the road. As such, the region should expect that riders will continue to endanger pedestrians by riding on the sidewalk on this section of road until an intervention is made to allow safe riding for both scooters and cyclists. Similarly, it should be noted that for the Stateline Transit Center corral location, riders who would like to go to destinations on the north side of the street such as the Chateau at the Villages would have to walk several hundred feet to the one crosswalk in this section of Highway 50, and then walk another few hundred feet to their intended destination. This alone might be a possible consideration for making the 1000 ft buffer only apply to destinations south of Highway 50 since it vastly diminishes the utility of the scooters, especially when cars are not subject to the same restrictions. The City could also evaluate multiple corral locations for the Villages area, which is probably the best choice to help provide access to the most popular origin and destination within the region.

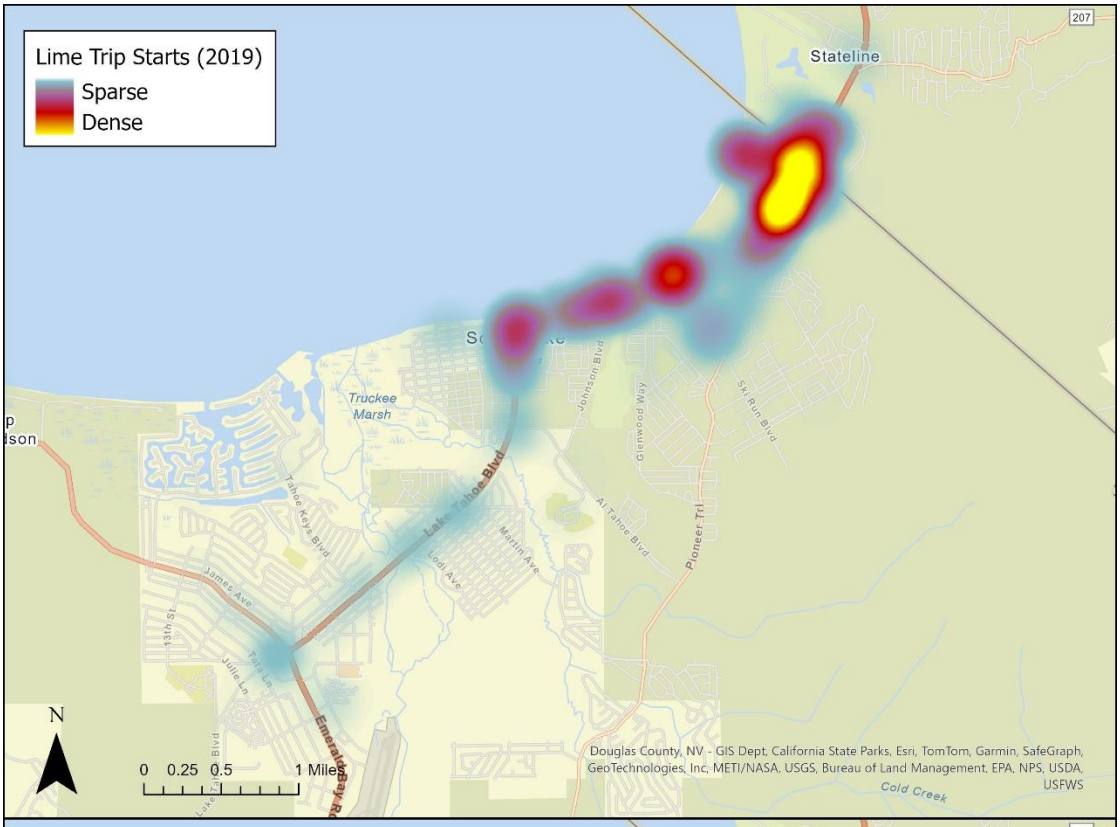
Another intervention that the region could consider is providing access to charging in the corrals. This would make it so that scooters need not be taken off-site by the scooter operators in trucks regularly. This would be a long-term solution and could be negotiated with the providers to ensure that there was adequate funding to offer such a solution. We would not recommend such a solution be considered in the short term due to the uncertainty in the future locations of corrals, and the fact that scooters do not yet have a unified charging standard. As such, both Lime and Bird use different charging cables and until scooter companies come to further agreement about how docking solutions may look in the future, it does not necessarily make sense for the City to invest in any kind of charging intervention so early in the evolution of this technology.

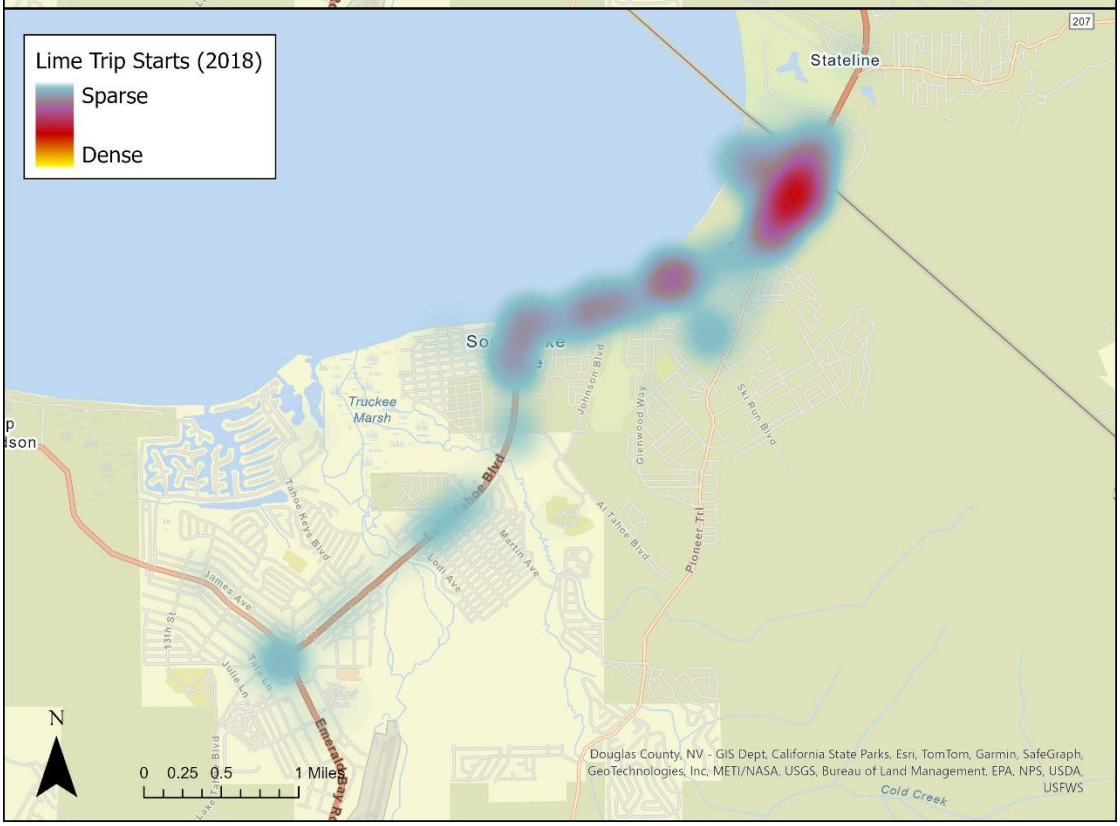
Appendix: Lime Ridership Over the Years




Lime Trip Starts (2021)
Sparse
Dense
Stateline
Truckee Marsh
Lake Tahoe Blvd
Pioneer Trl
Johnson Blvd
Glenwood Way
Ski Run Blvd
Al Tahoe Blvd
Martin Ave
Lodi Ave
Tahoe Keys Blvd
James Ave
13th St
Julie Ln
Tata Ln
Emerald Bay Rd
N
0 0.25 0.5 1 Miles
Douglas County, NV - GIS Dept, California State Parks, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS
Cold Creek
207


Lime Trip Starts (2020)
Sparse
Dense
Stateline
Truckee Marsh
Lake Tahoe Blvd
Pioneer Trl
Johnson Blvd
Glenwood Way
Ski Run Blvd
Al Tahoe Blvd
Martin Ave
Lodi Ave
Tahoe Keys Blvd
James Ave
13th St
Julie Ln
Tata Ln
Emerald Bay Rd
N
0 0.25 0.5 1 Miles
Douglas County, NV - GIS Dept, California State Parks, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS
Cold Creek
207


Lime Trip Starts (2019)
Sparse
Dense
Stateline
207
Truckee Marsh
Johnson Blvd
Glenwood Way
Ski Run Blvd
Lake Tahoe Blvd
Tahoe Keys Blvd
Al Tahoe Blvd
Pioneer Trl
Martin Ave
Lodi Ave
James Ave
13th St
Julie Ln
Trish Ln
Emerald Bay Rd
N
0 0.25 0.5 1 Miles
Douglas County, NV - GIS Dept, California State Parks, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS
Cold Creek


Lime Trip Starts (2018)
Sparse
Dense
Stateline
207
Truckee Marsh
Johnson Blvd
Glenwood Way
Ski Run Blvd
Tahoe Keys Blvd
Al Tahoe Blvd
Pioneer Trl
Martin Ave
Lodi Ave
James Ave
13th St
Julie Ln
Trish Ln
Emerald Bay Rd
N
0 0.25 0.5 1 Miles
Douglas County, NV - GIS Dept, California State Parks, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS
Cold Creek